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COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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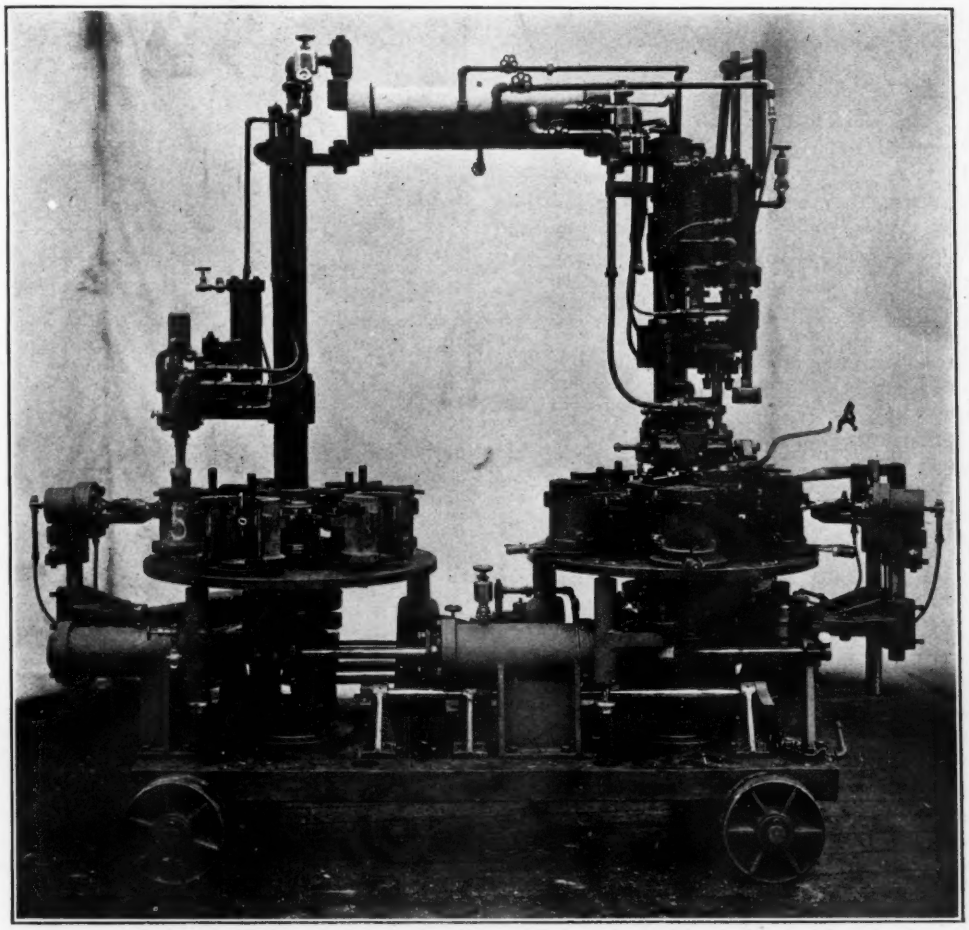


FIG. I. MACHINE FOR NARROW NECK BOTTLES.

AUTOMATIC BOTTLE BLOWING MACHINES

The photos here reproduced show as two interesting and ingenious machines in extensive practical use for the manufacture of bottles. They are built by the Cox and Sons Company, Bridgeton, N. J., and are extensively employed not only in the United States but in many foreign countries.

The machine shown in Fig. 1 is exclusively

for the manufacture of narrow mouth bottles, such as used for beer, soda water, catsup, proprietory medicines, etc. It is not practicable to describe the machine in detail for the general reader. It is a machine of numerous movements and these are all produced by compressed air, the several operating air cylinders being sufficiently in evidence. The operating pressure is from 20 to 35 lb. gage, this requiring to be adjusted and controlled with considerable nicety, and is accordingly taken care of by pressure regulators in the air supply system.

The molds for the bottles are shown upon the two intermittently rotating tables, the molds at the right being closed and those at the left being open. The end of the machine at the right of the picture is placed close to a glass melting furnace, and here a gathering boy inserts his gathering iron into the molten glass, turns to the machine and trips the lever *A* with his gathering iron. This trip lever admits compressed air to the machinery, first operating a set of shears which cut the required quantity of glass from the gathering iron, this glass then dropping into what is known as a blank mold. There then automatically descends a blow back cap, closing the end of the mold into which the glass has been dropped. Air is then introduced into the lower end of the blank mold, this forming the glass into what is known as a glass blank, and a plunger is inserted to form the mouth of the bottle. It then passes to the second stage and the third stage successively and then is removed by a transfer boy. In this transfer the glass blank is inverted and placed in the blow mold on the second table, it now being in the normal upright position. The operation of blowing the glass blank into a finished article is completed by the several operations in the rotation of the second table and the bottle is removed at the taking out point by a small boy.

It would be impossible to follow the passage of the air in this machine if a detailed description were attempted for the reason that the various passages and air connections cannot be traced in the photogragh. It is sufficient to say that when the air is introduced into the machine it passes from point to point, first performing one operation and then another, many operations taking place, such as the cutting, the forming and the solidifying of the blank, the absolute locking of the molds, the precise turning of the tables, etc.

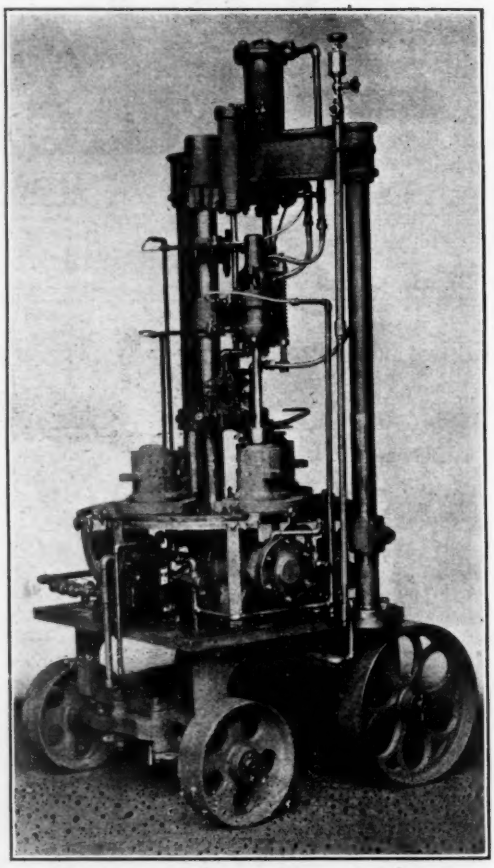


FIG. 2.

These motions are so timed that 12 to 15 bottles per minute are produced without intermission for 18 or 24 hours a day, 10 months in the year. The intricacy and the precision of construction and operation of these machines speaks for itself.

The necessity of uninterrupted operation of the machines may be appreciated from the fact that a stoppage of only three minutes for any adjustment will make a delay of 15 minutes until the bottles begin to be delivered again in acceptable condition. This is due entirely to conditions of temperature which

are disturbed by the stoppage, the heat of the glass itself when in steady operation being the correct adjusting medium.

The machine shown in Fig 2 is for the manufacture of wide mouthed ware. Practically the same principles are involved, but the glass blanks are formed in a different manner and the transfer of the glass blank from the blank mold table to the blow mold table is accomplished mechanically, so that this machine requires only one skilled gathering boy and one unskilled small boy to remove the finished bottles.

THE HAND PROCESS OF WINDOW GLASS MANUFACTURE

BY ROBERT LINTON*

Glass does not have a definite melting point, in the sense of a fixed temperature at which it passes from a solid to a liquid state. Strips of window glass have showed a slight deflection at 840 deg. F., while they lost stiffness at 920 deg. and bent freely at 980 deg. The glass becomes softer as more heat is applied, and at 1,700 deg. it becomes so liquid as to readily assume the shape of a vessel into which it is poured. With the application of more heat the glass becomes still more and more fluid until finally a point is reached where a slight decomposition and loss of alkali takes place, which manifests itself by bubbles of gas rising through the heated mass.

PLATE GLASS AND WINDOW GLASS

There are two kinds of transparent sheet glass, termed commercially plate glass and window glass, manufactured by two radically different operations. In making the former, a quantity of molten glass is poured upon a casting table and rolled out in a sheet which is placed in a kiln where it is annealed and cooled. The sheet produced in this way is rough, as the metal table and roller, no matter how smooth, will leave an impression on the soft glass; consequently it has to be ground down to a plane surface on both sides and then polished in order to render the surface smooth and the sheet transparent.

Window glass is made by blowing or drawing a cylinder in such manner that nothing but air comes in contact with the surfaces during the operation, cutting open the cylinder longitudinally, reheating it, and flattening it out in a sheet which is then annealed.

In the hand process of manufacture, which only began to be superseded in 1903, the tool used is the blowers pipe, about five feet long, with a mouth piece on one end, and on the other the belt-shaped wrought iron "pipe head." The workmen are the blower, the gatherer and the snapper, or blower's helper, the three men constituting a "shop." The gatherer starts the operation by dipping the pipe head, which has been previously heated, into the molten glass which adheres and forms a small ball. He blows through the pipe sufficiently to expel the soft glass from the interior and form a small bubble in the ball. The glass is then cooled to the proper stiffness, more glass is gathered and the operation repeated until there is sufficient glass to yield a cylinder of the desired size. For an ordinary cylinder the gatherer usually gathers five times.

The lump, which is in a state of rather stiff plasticity, is then carried to the "blower's block," an iron mold set in water to keep it from becoming too hot, and lined with charcoal to prevent the glass from being marked by contact with the iron. By turning the ball in the block, blowing air into the lump through the pipe and drawing it up towards him, the blower so manipulates the operation as to form a pear-shaped ball, the upper part of which has the diameter and thickness of the cylinder to be produced, the bottom containing a thick mass of glass that has now become quite stiff. The ball is now reheated in a "blow furnace" and when soft enough, the blower swings it out in a "swing hole" alongside the blow furnace. The weight of the glass elongates the cylinder and the blower keeps it distended to proper diameter by intermittently blowing air into it through the pipe. The reheating and swinging out is repeated until the glass in the closed end of the cylinder is of the same thickness as the other parts. This closed end is now exposed to the heat of the blow furnace, the workman at the same time blowing into the pipe and keeping the air confined by holding

*From a Paper before the Engineers' Society of Western Pennsylvania.

HAND BLOWING OF WINDOW GLASS.

his thumb over the mouth piece. The glass in the end softens, and the heat at the same time expands the air in the cylinder, which finally bursts out through the end. The open end is heated still further and swung out into the swing hole in such manner as to make it cylindrical to the end. The pipe is removed by touching a cold iron to the glass just below the pipe head, and the pear-shaped cap removed by stretching a thread of hot glass around the cylinder, allowing it to remain until a heated streak is formed, and touching this streak with a cold iron causes the cap to snap off. The cylinder is split by passing a hot iron back and forth through the cylinder to produce a similar line of heat and touching it at one end with a cold iron, which results in a straight crack from end to end.

The cracked open cylinder is then carried to a flattening oven. It is laid on an iron carriage and pushed into the oven, where it is heated, lifted with an iron tool from the carriage and laid on the flattening stone—a large, flat fire clay tile with a carefully levelled and highly polished surface. As the glass softens the cylinder is spread out and then rubbed down flat with a wooden block mounted on a light steel bar. The stone with the sheet lying on it is then moved out of the flattening compartment into a cooler one, the sheet is gradually cooled down and when it is sufficiently hardened, it is lifted by means of a fork with smooth steel tines and laid on a conveyor which carries it slowly out of the oven. This part of the oven, called the "lehr," is for the purpose of annealing the glass by cooling it slowly and gradually, for otherwise it would be too brittle for commercial use. The ordinary type of flattening oven has four flattening stones set on a circular table—the "wheel"—which is carried on a vertical shaft turned by hand from a bevel gear drive.

It will be readily appreciated that blowing window glass requires unusual judgment and manual skill, as well as more than ordinary physical strength and endurance; also that the size and thickness of sheets that can be produced by hand is quite limited. In single strength (1-12 in. thick) the limit is about 14 in. diam. by 60 in. long; in double strength (1-8 in. thick) about 19 in. diam. by 70 in. long.

The workers were extremely well paid. Blowers' wages ordinarily varied from about $150 to $250 per four weeks, and gatherers from about $110 to $150. Blowers who made the largest sizes were paid much more than this. I remember one "big blower" in a factory with which I was connected who earned $642 in four weeks.

By August the Government expects to get from American sources all the dyes it uses in printing stamps, paper currency, and the like.

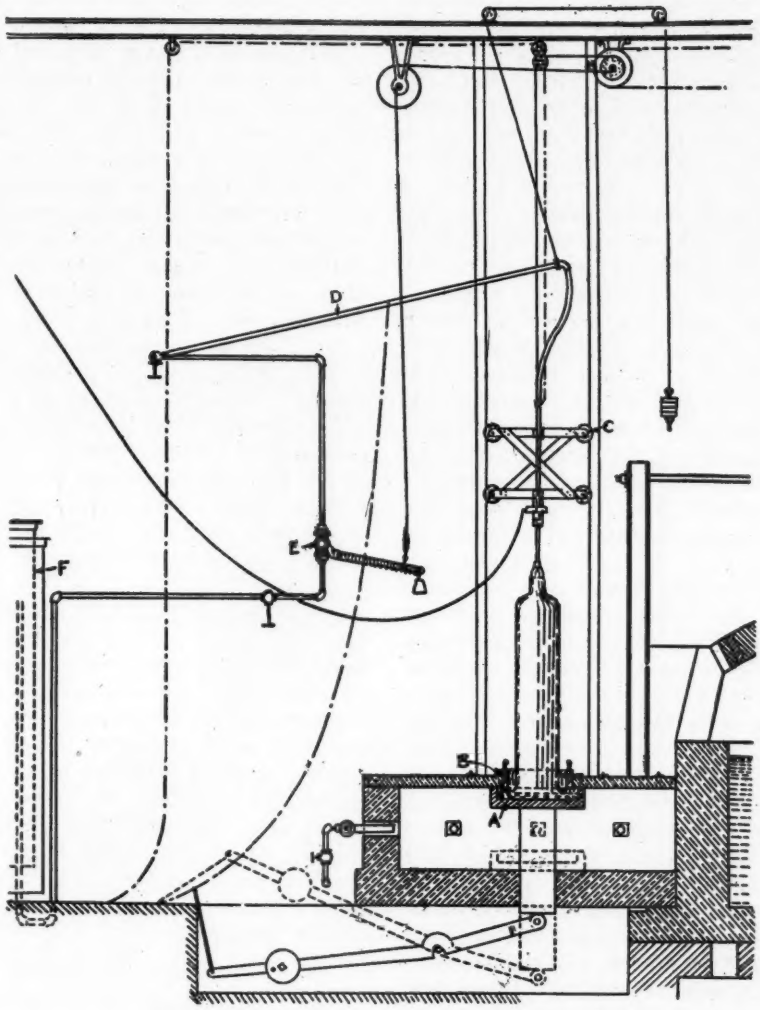


FIG. 1. SKETCH OF FIRST WINDOW GLASS MACHINE.

WINDOW GLASS BY MACHINE*

BY ROBERT LINTON

Somewhere around 1896 John H. Lubbers, a window glass flattener by trade, began experimenting with a machine to make glass cylinders. A small company was formed for the purpose of carrying on the experiments, but it required years of work and an enormous amount of money to develop the apparatus to the point where it was finally operated at a profit.

*Abstract from Engineers' Society of Western Pennsylvania

The Lubbers process is for drawing cylinders vertically from a bath of molten glass, and Fig. 1 is a sketch of the first machine ever successfully employed for the purpose. A is a flat bottomed, circular pot placed in a heated kiln and movable vertically; B is a circular water cooled shield; C is a crosshead traveling on guides, raised by means of a cable winding on a cylindrical drum and carrying a detachable blow pipe of the general type used in hand blowing; D is a supply pipe for the admission of air under sufficient pressure to keep the cylinder distended to proper diameter; E is a graduat-

ing valve which is automatically opened as the crosshead C is raised, the valve being provided with a slotted opening of proper size and shape to admit the requisite quantity of air at each point of draw; F is a gasometer serving to maintain a constant pressure in the supply line conveying air to the graduating valve.

The operation was as follows: The pot A was raised to the top of the kiln and the water shield placed in the position shown. A quantity of glass sufficient for drawing one cylinder was ladled into the pot. A ball of glass was gathered on a blowpipe, the small bubble blown out as in hand blowing, and the ball "marvered," or rolled on a smooth iron plate, so as to thin the bottom portion beneath the bell shaped end of the pipe; the pipe was then hung on the crosshead and lowered into the glass. The crosshead was then raised, air being admitted by the operation of the graduating valve, which swelled out the glass to the diameter of the cylinder to be drawn. The upward movement was then continued until the cylinder reached the desired length, the introduction of air being automatically regulated by the graduating valve. The cylinder was severed from the glass remaining in the pot in any one of several ways—either by dropping the pot and allowing the heat to melt the lower end, by shearing off, or by shutting off the air and continuing the upward movement, which contracted the lower end of the cylinder to a small cord which was sheared off. The pipe with cylinder attached was removed from the cross-head, lowered to a horizontal position, the pipe removed and the cylinder capped off as in hand blowing operations. The pot was lowered to the kiln to reheat it and melt to proper consistency the residue of glass that remained in it.

The control of the machine by the operator was at that time limited to stopping, starting or reversing the drum on which the cable wound that raised and lowered the crosshead, and in manipulating a hand valve on the air supply line between the gasometer and the graduating valve.

Out of this crude apparatus, and after years of costly experimenting, was perfected a machine that is producing to-day results far beyond the most optimistic expectations of its inventor. One by one the causes of the troubles were located and the apparatus modified or adjusted to correct them.

That this work was so slow and so difficult was largely due to two facts which have been mentioned, viz.: First, that in the liquid state in which glass is worked in machine operations, it is so soft as to be extremely sensitive to changes in temperature or variations in exterior or interior pressure exerted at the point of draw; and second, that in working glass, cooling strains develop as the glass passes from the liquid to the solid state, causing brittleness.

The method of reheating the residue remaining in the pot after drawing a cylinder and then ladling fresh glass into the pot was not very satisfactory. It was difficult to get good quality of glass, for unless the glass in the pot and that which was ladled into it were heated to the same temperature and brought to a very fluid condition, they would not mix properly, and thus streaks would be produced.

It was then proposed to drain the pot between the draws, and to accomplish this a furnace was built with four pots mounted on a turn-table and so arranged that each pot would be tilted at a certain point. In this way there would always be one pot used for drawing cylinders while the others would be heating and draining. An improvement on this apparatus was the double reversible pot mounted on trunnions shown in Fig. 2, in using which one side was always being drained while a cylinder was being drawn from the glass on the other.

THICK AND THIN SIDES

It was also discovered that there was gradual cooling of the glass during the draw, and that is was important to control this so as to prevent one side from cooling more rapidly than the other as far as could be done. The effect of inequalities in the temperature of the bath is to produce "thick and thin" glass, i. e., that portion of the circumference of the cylinder where the glass is coolest at the point of draw will always be the thickest; also in many cases this inequality in temperature causes the cylinder to travel towards one side of the pot instead of continuing to draw vertically from the starting position. A great deal of difficulty was experienced in eliminating this "thick and thin" glass, as it could be

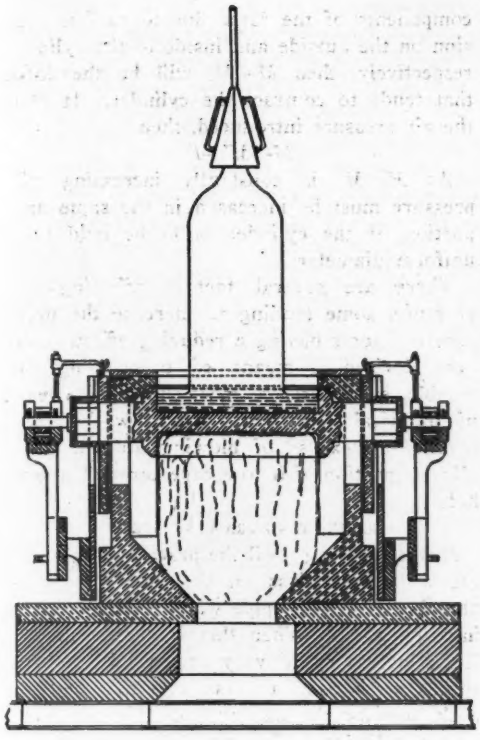


FIG. 2.

due to a number of causes. More positive adjustment of the machinery, an improved type of ladle and method of ladling the glass from the tanks to the pots, more care in keeping the pots uniformly heated, and shielding the glass bath from draughts, very greatly reduced the proportion of "thick and thin" glass produced. It was, however, found so difficult to maintain absolute uniformity in the temperature and rate of cooling of the bath, that the practice was finally adopted of drawing from the center of average viscosity, instead of from the center of the pot. In other words, when the glass in a place is thick and thin, and the apparatus is in proper condition, the blow pipe is simply moved sufficiently to bring the thickness uniform or practically so for the entire circumference of the cylinder.

It was thought in the early days of machine operations that some change in the chemical composition of the glass, or in the character of the materials from which it was made, would be necessary in order to adapt it to the new working conditions. The cylinder was now being drawn from glass in a liquid condition, while the hand blower manipulated a lump sufficiently stiff to be retained on the end of the blow pipe. The glass was worked out of the tank much more rapidly, which accelerated the flow proportionately. The maximum amount of glass gathered in 24 hours from one of the tanks under hand operations was 3.7 per cent. of the total contents, while under machine operations more than 20 per cent, has been ladled from the same tank in 24 hours.

INCREASING THE SIZE OF CYLINDERS

The original Lubbers' machine made a cylinder about the size of a hand blown cylinder, but it soon became obvious that production could be materially increased by ladling a larger quantity of glass into the pot and drawing a longer cylinder. This introduced complications in the control of drawing speed and air supply, but eventually the point was reached where five flattening lengths about 14 in. in diameter by 60 inches long could be produced at one draw.

The next step—and a most important one in increasing production—was to increase the diameter of the cylinder. It was not possible to flatten a single strength cylinder that was much larger than the standard size of 14 in. in diameter by 60 in. long. It was suggested, however, that there would not be any difficulty in flattening if the conditions should be reversed and flattening lengths produced which would be 19 in. diameter by 42 in. long, employing of course pots of larger diameter and containing a larger quantity of glass. The size of the cylinders has since then been considerably increased, so that to-day, using a 36 in. pot, single strength cylinders are made up to 21 in. diameter by 460 in. long, and double strength up to 24 in. diameter by 320 in. long.

REGULATING THE AIR PRESSURE

Lubbers had discovered three fundamental facts in his earlier experiments: First, that the air supply must be held at constant pressure; second, that unless the quantity of air supplied to the interior of the cylinder was constantly and uniformly increased during the drawing operation, the cylinder would taper off to a point; and third, that no ordinary type of hand manipulated valve on the air

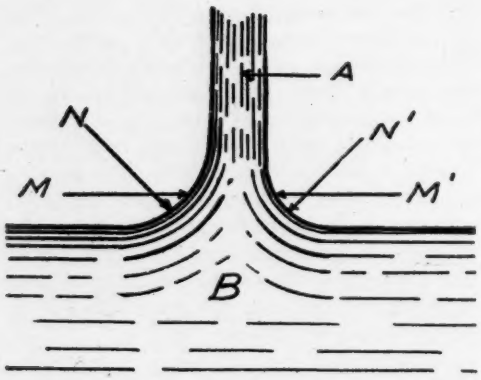


FIG. 3.

inlet line would regulate the increase delicately enough. These conditions were provided for by using a gasometer for regulating the air pressure and a special automatic graduating valve for controling the rate of increase of the air supply.

SURGING

As the length of the cylinders was increased another complication entered. It was found that even with the graduating valve opening and increasing with automatic precision the amount of air entering the cylinder, the pressure at the point of draw was not constant, but was applied in a series of surges which produced corrugations in the cylinder, termed "pulsations." For the purpose of better understanding the cause of these let us consider the condition of the glass at the point of draw, and some of the factors affecting the air pressure inside the cylinder.

In Fig. 3, A represents the wall of a cylinder being drawn from the bath of liquid glass B. The surface tension of the glass in the meniscus outside of the cylinder is N, and N' the surface tension of the meniscus inside the cylinder. Now N will always be greater than N', because the surface of the glass in the pot outside of the cylinder cools by free radiation and convection in the atmosphere, while the surface of the glass inside cools by radiation through the cylinder and convection currents set up by what air is confined within the cylinder. The difference is doubtless very slight at the beginning of the draw, but increases gradually as the draw progresses. Now since N is greater than N' the wall of the cylinder will be gradually pushed over towards N', unless held out by pressure. If we call M and M' the horizontal components of the force due to surface tension on the outside and inside of the cylinder respectively, then $M—M'$ will be the force that tends to contract the cylinder. If P is the air pressure introduced, then

$$M—M'—P$$

As $M—M'$ is constantly increasing, the pressure must be increased in the same proportion, if the cylinder is to be held to a uniform diameter.

There are several factors affecting the pressure, some tending to increase the pressure and some having a reducing effect. Lubbers devised a means of overcoming the trouble, sufficiently to meet the requirements of practical operations, which was to introduce an excess of blowing air and then allow a portion of it to escape through a vent hole.

REGULATING DRAWING SPEED

It was not long until the practice of gathering a ball of glass on the blow pipe was abandoned, and the pipe was lowered directly into the glass. When this was done it was found necessary to vary the speeds. Three speeds were used at first, one to form the neck, one for the cap and one for the body of the cylinder. This was later changed so as to use one speed for the neck and cap, one for the body of the cylinder and one to thin the lower end for shearing off.

It was also observed that the glass in the pot was gradually cooling as the drawing progressed, and therefore the walls of the cylinder were gradually thickening. The speed was therefore gradually increased, the increase being adjusted so as to compensate for the increasing viscosity of the cooling

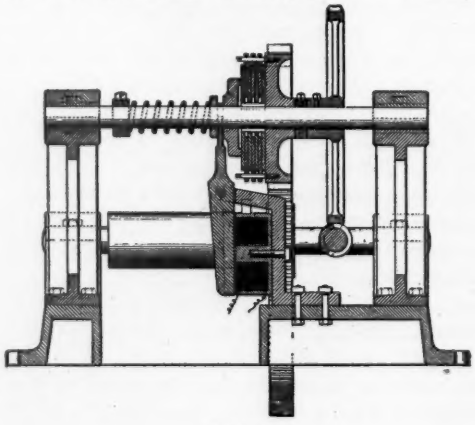


FIG. 4.

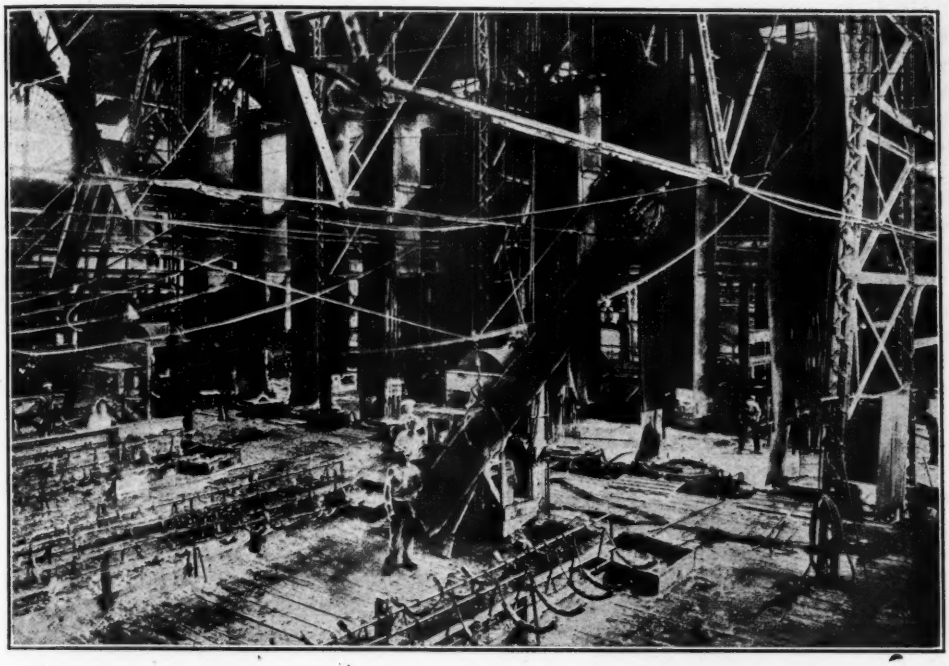


FIG. 5.

glass, and thus produce a cylinder of even thickness longitudinally.

Two factors control the thickness of the glass in a cylinder, first, the viscosity of the glass—governed by its temperature, and second, the speed of draw. The same thickness may be drawn from glass of different temperatures, if the speed is regulated to compensate for the variations in viscosity. The problem is, however, complicated by the necessity of drawing glass of even thickness around the entire circumference, by the necessity of preventing excessive cooling strains, and of avoiding loss of time as far as possible. In early operations there was considerable difficulty in keeping the thickness of the product up to standard single strength, and there was quite a little loss due to the production of thin glass that could not be marketed. As the machine became perfected, it was not only possible to produce good, standard single strength, but also double strength and heavier grades up to three-sixteenth inch.

Several types of mechanism for raising the cross-head were tried, the one finally adopted being a motor driven geared hoist. This was provided with a friction clutch held in position by a strong spring. An electro magnet was used to release the clutch so that the cross-head could be lowered after the draw. This type of hoist is shown in Fig. 4.

FINAL HANDLING OF THE CYLINDERS

In the early Lubbers' apparatus there was a cord attached to the blowpipe during the draw, this cord passing through an overhead pully. After the draw was completed the pipe, with the cylinder attached, was detached from the cross-head by pulling this cord and lowering while still attached to the cord, to a horizontal position. The hoist with the magnetic clutch control made it possible to lower the cylinder by simply swinging out the lower end, using curved supports, "taking down hooks," to support it, and slowly lowering the cross-head at the same time on which the pipe and cylinder still remained suspended. This was hard and dangerous work for the men who handled the taking down hooks, and considerable experimenting was done with a view to providing apparatus for taking down the cylinders mechanically. The device that was finally adopted and which is now in general use is seen in Fig. 5.

This brief outline gives very inadequate idea of the immense amount of study and research expended on the various problems involved, and the numerous alterations in the mechanical details that were found to be necessary while the machine was being developed and conditions of machine operation determined. It was a tedious and difficult task, but one by one the difficulties were overcome until finally machine operation attained such a degree of success as to dominate the window glass business of this country and has reached out to new fields abroad.

Machine operation has immensely increased the output per tank and output per man in the blowing room. The machine blower, operating four machines, displaces on an average eight hand blowers, and not only this, he produces a great deal more glass than the eight hand blowers could possibly make. The whole labor force of a present day machine blowing room is less than half the labor force in the blowing room of a hand operated plant. Under hand operation a tank furnace was rated as so many blowers' capacity. A 48-blower tank, for instance, was a tank designed to melt sufficient glass to supply 16 blowers on each of the three working shifts; it was estimated that if the blowers all worked to the limit of capacity fixed by union rules it was as much glass as the tank would melt. The same tanks after being remodeled—not enlarged, or only slightly enlarged—have yielded an output in finished glass that has shattered all records in hand blown operation, and completely upset all previous ideas of tank capacity.

Not only in point of capacity, but as regards quality of product as well, has the machine scored a remarkable success. In the early operations a great deal of doubt was felt as to whether machine glass would ever equal hand blown glass in quality. Now the standard is set by machine made glass, which is recognized as the highest and most uniform quality produced in this country or abroad.

A SPECIFIC GRAVITY BALANCE FOR GASES

This is the subject of technologic paper 89 of the Bureau of Standards. The need for an accurate method of determining gas densities has been especially urgent in the natural gas industry, where the measurement of gas by means of orifice meters requires a knowledge of the density of the gas. An investigation by this bureau of the effusion type of apparatus, which has been generally used for this purpose, but which has proven unreliable in practice, has shown the need of more precise methods. The apparatus described in this publication provides a quick, accurate means of determining gas density. The balance beam is supported on two needle points which give high sensibility. The needles are easily adjustable and in contrast with the metal or quartz knife edge usually used can be obtained almost anywhere, are inexpensive, and can be replaced as often as necessary. The success obtained in the use of this apparatus is mainly due to the high sensibility afforded by this means of support.

GAS AND GASOLINE IN SEWER EXPLOSIONS

In the city of New Haven, Conn., as far back as 1886, there was an explosion of a 60-inch round sewer. The force of the explosion was so great that the arch was thrown off completely for a distance of about 100 feet. (Fig. 1.) Nobody seems to know how that explosion occurred, and luckily nobody was hurt.

Some eight years later, in the same old town, a 54-inch round brick sewer was undergoing the process of cleaning out. Four men were busy on the job, when suddenly an explosion occurred in the sewer. Luckily, the men escaped death, but two of them were disabled for six months or more. It was decided that the explosion appeared to be from illuminating gas in the sewer.

And as recently as 1913 New Haven once more experienced a sewer explosion. This time it was in a 42-inch, egg-shaped, brick sewer. Like the last mentioned explosion in the 54-inch sewer, this one was being cleaned when the explosion occurred. It did not kill the men. They were just burned about their hands and faces.

People were inclined to blame illuminating gas again for the mishap, but investigation showed that a factory nearby allowed gasoline drips to enter the sewer. When this

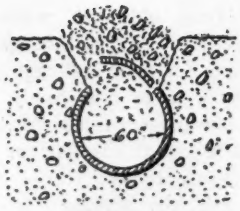


FIG. 1.

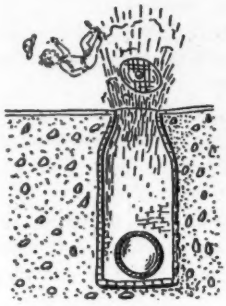


FIG. 2.

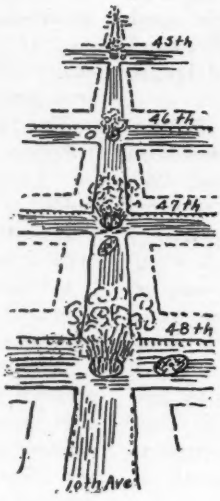


FIG. 3.

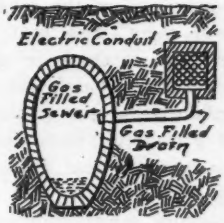


FIG. 4

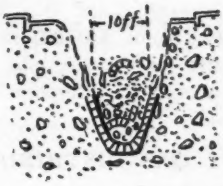


FIG. 5

TYPICAL SEWER EXPLOSIONS.

fact was unearthed, a workman remembered having detected the odor of gasoline when he first entered the manhole.

If gasoline was really the cause of that explosion, and if it came from the manufacturing plant, whose gasoline drippage was very small, the incident may be taken as very good proof that a very small quantity of gasoline in a sewer can do a great amount of damage. It also goes to show how necessary it is for garages, both public and private, to have proper gasoline trap floor drains, that will positively prevent gasoline from getting into sewers.

In Philadelphia, an explosion occurred in a sewer which killed several men. Part of the report of the chief engineer of the Bureau of Sewers is as follows: "A suspicious smell was noticed upon opening a sewer manhole, and a blazing paper thrown in resulted in a column of flame about 40 feet in height, due to gasoline from a nearby factory." (See Fig. 2.).

But when it comes to doing anything on a big scale, we must look to New York City. There they had a rather spectacular explosion in 1909. It affected not one block or even two, but the whole territory within half a mile square.

It is recorded that in this particular case in the sewer at 48th street and 10th avenue. a violent explosion was heard at 4:40 P. M. A few seconds later, another explosion further south on 10th avenue got the people on edge. Then a regular bombardment of big guns appeared to be on. Explosion after explosion ran along 10th avenue for half a mile, and up the cross streets. The enemy batteries were underground, for with every explosion, flames burst from manholes and dense clouds of black smoke filled the streets. (See Fig. 3). The telltale black smoke was the convincing exhibit that sealed the verdict against gasoline in New York sewers for evermore.

Although the ban was put on gasoline vapor, there are other substances that can explode in sewers and keep folks busy. Illuminating gas, for instance, from leaky street mains sneaks into sewers like the small boy under a circus tent. (See Fig. 4.)

Even the electric conduits under the streets are sources of danger when inflammable gas of any kind exists in a street sewer. Just two years ago a case of this kind occurred near 42nd street. The conduit was drained into the sewer. It is believed that an explosive mixture was in the conduit as well as in

the sewer and in the cross connecting drain between them, and that an electric spark ignited the mixture in the conduit, which flashed back through the drain and ignited the inflammable gas of the sewer.

But Pittsburgh wins the pennant, when it comes down to real damage and cussedness in sewer explosions. For in November, 1913, a disastrous sewer explosion which occurred there, disturbed the usual steadfast equanimity of that great manufacturing town. A whopper of a main trunk combined sewer, some ten feet in diameter, was burst asunder for a distance of 5,000 feet. (See Fig. 5.) Manholes were destroyed, windows were smashed and streets caved in. This explosion cost the city some $300,000 to repair. The costs of suits for damage may run the cost up to half a million.—Plumbers' Trade Journal.

CITY GAS DISTRIBUTION SYSTEMS

Distribution systems may be divided into three classes: Those operated under low pressure, those under medium pressure and those under high pressure. As a distinction between the classes some defined pressure range must be given each. Systems carrying pressures up to one pound (27 in. water) may be classed as low pressure systems, those carrying from one to five pounds as medium and those carrying above five pounds high pressure systems. A number of combinations of the above systems are used in various cities, most of which have been evolved as a modification of some existing system.

In the early history of the gas industry all distribution was done under low pressure, but as the business developed the need of greater carrying capacity in the existing mains or larger mains became apparent, and as the former was possible by increasing pressures, the result was an evolution in distributing systems which has resulted in the high pressures so generally used today, and which has made possible the distribution of gas to small communities from a centrally located plant which otherwise would never have been supplied.

The benefits derived from this evolution in gas pressure have not been confined to the new customers obtained by supplying isolated districts. Better service has resulted from the efficient control of pressures, which has resulted in revenue from new customers and increased revenue from old ones, while installation costs have been reduced through the use of smaller and cheaper wrought iron mains instead of the large and costly cast iron pipes used in low pressure distribution.

The following is a list of the various distribution systems in use today:

1. Distributing with low pressure from a holder or holders, located at the plant.

2. Distributing with low pressure from both station and district holders.

3. Distributing with low pressures, but supplying district holders through medium or high pressure lines.

4. Distributing with low pressure, the low pressure mains being reinforced through district governors from a belt line carrying medium pressure.

5. Distributing with low pressure, the low pressure mains being reinformed through district governors from a belt line carrying high pressure.

6. Combination pressure being used. The pressure being raised at the plant to suit requirements in outlying districts, individual regulators being used on the services adjacent to the plant and along feeder mains where required.

7. Medium high pressure carried on all mains with individual regulators on each service.

8. High pressure carried on all mains with individual high pressure regulators on each service.

The above list shows plainly the evolution through which distribution systems have passed. Each system has its special advantages provided the system is adapted to the particular city in which it is used. There can be no fixed rule as to which system is the best to apply to all cities, but, due to the flexibility and low first cost, No. 6 consummated in No. 7 is adaptable in most cases.—*Gas Age.*

WHERE A COMPRESSED AIR MISSIONARY IS NEEDED

The two air pressure records here reproduced were exhibited at a recent meeting of the Lancashire Branch of the National (British) Association of Colliery Managers They were shown for the purpose of telling the story of the correcting of the fluctations of air pressure which occurred at Chapel Col-

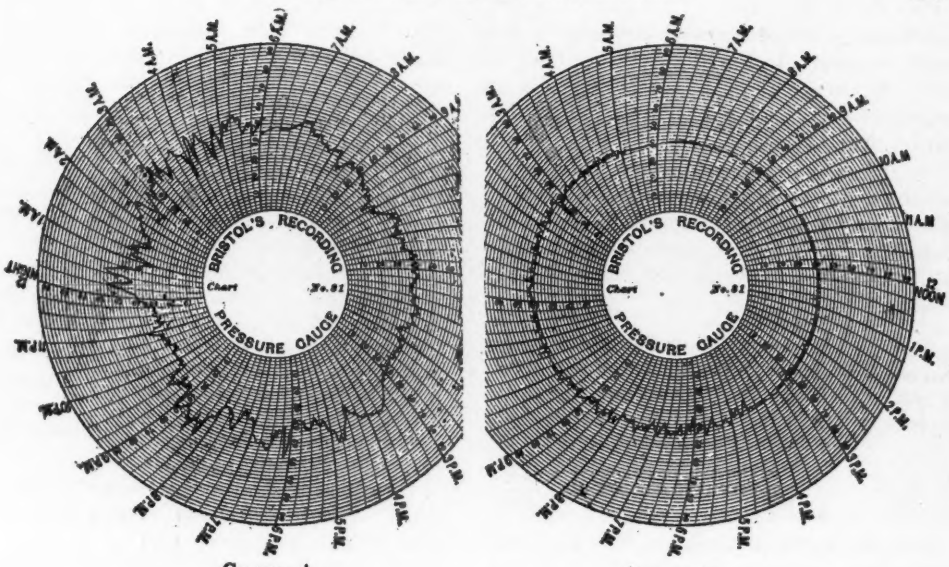


CHART A. CHART B.

SHOWING THE LOW PRESSURE USED.

liery, chart A being before and chart B after the change. As to what was actually done in the matter we are told as follows: "In the absence of automatic control of the pressure of the compressor, control of the pressure by the engineman was arranged by leading a chain gear from the throttle valve of the compressor steam engine to a convenient position. The engineman also noted each hour from the revolution counter the number of revolutions made by the compressor. A time table for the several coal cutters was arranged in diagram form, with a view to distributing the demand for air as uniformly as possible throughout the cutting shifts, and on the same diagram the average number of revolutions made by the compressor in each hour was plotted. Not an ideal or very satisfactory arrangement at the best. There should have been an entirely automatic control and adjustment of the air pressure, and there should have been a sufficient air supply for all the coal cutters that might at any time require it to operate to the best advantage independently of that.

ABSURDLY LOW PRESSURE USED

These records are reproduced here, however, more for the purpose of calling attention to the absurdly low pressure apparently regarded as satisfactory. It will be noted in chart B that the pressure is maintained at 40 lb. gage, never being allowed to rise above that. This, it will be understood, was in the compressor house, while at the machines when in operation the pressure could not have been above 35 lb. It must be said that management and men who can potter along with such pressures as that do not know anything about what compressed air machines will do, and they should have somebody to show them what successful practice is.

ELECTROLYTIC OXYGEN DANGEROUS

There occurred in California last summer, within three days of each other, three fatal explosions of oxygen tanks used in oxyacetylene metal cutting and welding. Seven men were killed and five more seriously injured. An investigation which immediately followed under the direction of John R. Brownell, Superintendent of the Department of Safety, Industrial Accident Commission, brought out the fact that the explosions were due to the presence of hydrogen in the tanks commingled with the oxygen in sufficient proportion to form highly explosive mixtures. An account of the investigation and its results is contained in the first issue of California Safety News, the essential portion of which is here presented:

All three explosions occurred in tanks of oxygen supplied by the same manufacturer, who had used what is known as the "electrolytic" method in obtaining oxygen. Each

explosion occurred immediately after a new tank of oxygen had been put in use, and all were found to be due to the presence of an explosive mixture of gases in the oxygen tanks. The pressure in the three tanks varied from 350 to 2,200 lb. per square inch. Five other tanks were recalled from customers to whom they had been shipped by the same manufacturer. The contents of these tanks were carefully analyzed, with the following results:

Tank Number	Per cent O	Per cent H	Per cent CH	Per cent N
X10980.....	99.5	0.6	0.1	0.4
X11063.....	54.25	42.5	0.53	3.18
X13553.....	28.3	69.0	0.30	2.43
X 9233.....	42.3	52.55	0.6	4.6
X10789.....	41.05	55.0	0.48	2.98

The investigation developed the fact that while these tanks were being filled it was necessary to make repairs to one of the electrolytic cells at the company's plant, and one of the repairmen accidentally interchanged the feedline connections of a set of twenty cells, causing the poles to be reversed, and resulting in the mixture of hydrogen with oxygen which went to the container from which the tanks that later exploded were filled.

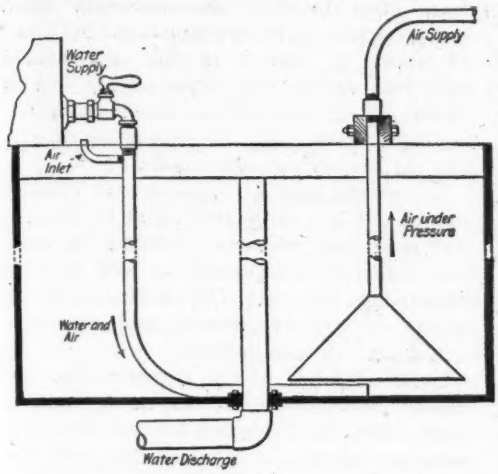
COMMISSIONER'S RECOMMENDATIONS.

The commission pointed out that *oxygen manufactured by the liquid-air process does not contain hydrogen.* If oxygen manufactured by other processes is used it should be ascertained that the hydrogen content be less than 2 per cent. The user of oxygen made by the electrolytic process, the commission recommends, should satisfy himself that the following precautions are taken by the manufacturer:

1. Every electrolytic oxygen plant should be equipped with a system of purifiers, the purpose being to eliminate, as far as practicable, the presence of hydrogen in oxygen.
2. All electrical connections should be so constructed that they will be non-interchangeable.
3. A device should be installed for the purpose of preventing reversal of current between the generator and the cell connections.
4. High-pressure gages should have safety relief features.
5. Tests of both hydrogen and oxygen should be made every two hours where the capacity of the system exceeds 100 cu. ft. per hour. This test should be run alternately with gas obtained from the gas holder and from the line between the cells and the gas holder. (The purpose of the test is to check up the gas being shipped out and also the gas which is going into the gas holder.)
6. Each plant should have gas holders of sufficient size to take the capacity of the plant for at least two hours.
7. All hydrogen tanks should be provided with fittings which are non-interchangeable with those of the oxygen tanks. It is recommended that the former be left-hand fittings and the latter right-hand fittings.
8. Each cell should be equipped with a "relief" feature, the purpose being to safeguard against back pressure.
9. A complete record of each test, as well as any important features connected with the process, should be kept and turned over to the management or authorities competent to examine it.
10. A competent operator should have supervision of the plant. He should be thoroughly familiar with the making of tests and the reconstruction of cells, and should be sufficiently acquainted with electricity and its application to electrolytic oxygen manufacturing competently to take care of any disturbances.

A LABORATORY HYDRAULIC AIR COMPRESSOR

The cut here reproduced from a recent issue of Engineering and Mining Journal, contributed by Mr. A. W. Allen, shows an interesting adaptation for laboratory use of the principle of the Taylor hydraulic air compressor, which, as our readers know, has been successfully employed for the compression of large volumes of air delivered at pressures up to 100 lb. Water flows freely from the faucet up at the left and as it drops down the pipe it carries more or less air entrained with it. The air thus mixed with the water might as well be admitted by a number of little holes drilled in the pipe coupling immediately below the faucet instead of by the air inlet pipe shown in



LABORATORY LOW PRESSURE COMPRESSOR.

the sketch. The height of the faucet above the surface of the water in the tank should be greater than here indicated or the flow will be slow and the air delivery very small. The water, with the air it carries, is discharged from the open end of the pipe under the middle of the suspended conical hood. The air accumulates in this hood and is carried off under pressure by the ascending pipe. The accumulation of water will overflow at the surface of the water in the tank and escape down the discharge pipe. The pressure of the air delivered will be determined or limited by the height of the water surface above the top of the hood, and of course cannot be great. It would be sufficient for blowing purposes but of course not for operating pneumatic tools. The water may be used over and over by pumping.

IMPROVED AIR BLAST FOR HARDENING TOOLS

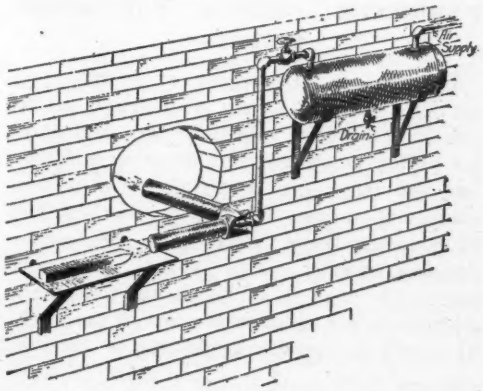
BY J. V. ARTHUR

Have you walked by the tool dresser's fire, day after day, and heard the roar of the blast of compressed air escaping where it is used for chilling the cutting edges of the lathe and planer tools? And have you wondered whether anything could help relieve this tax on an already overloaded compressed-air plant? The tool dresser will tell you that he needs lots of air, because that being used is too hot for good hardening. Incidentally he will probably complain that the air carries so much moisture that the water is causing the steel of the tools to check, and out will come a display of several tools that were "perfectly good" before they were put before the air blast.

Those were a few of the conditions that the air installation, shown in the accompanying figure, was designed to meet. In this particular case the air blast was located immediately above the steam-heating coils, so there was a probability that the temperature of the surrounding air was relatively very much higher than that of the rest of the room. The nozzle was at that time arranged to blow into the open end of a piece of 3-in. pipe about 12 in. long, the air coming out of the other end upon the tools in a diffused condition, so that it would cover a larger portion of the work placed before it. At the same time the air blowing into the open end of that pipe created a suction that carried a large volume of the outside air through the pipe with it, so that really the volume of air delivered for cooling the tools was greatly increased.

To overcome the difficulties due to the hot inside air, an elbow was placed on the 3-in. pipe with an extension through the outside well to draw in cool air. Then using a side-outlet elbow, the air nozzle was drawn to a point and extended in about 2 in. This arrangement formed an injector, which delivered several times the amount of air to the tools that the system would otherwise have permitted.

The problem of the disposal of the excess moisture in the air was met by the installation



AIR BLAST FOR TOOL HARDENING.

of the small tank in the pipe line close to the air-blast connections. This tank, about 10 in. in diameter by 20 in. long, was made of galvanized sheet steel with welded seams and was fitted with a small drain cock at the bottom. The drain cock was for the purpose of drawing off any water that might condense in the tank.

Since this installation was made, the shop has been very successful with the tools that have been redressed. Perhaps this has been due in part to the greater interest taken in seeing that the work should come as near right as possible, but it also seems probable that the elimination of a large part of the trouble caused by the old air blast has had considerable to do with the better results that have been obtained since the installation of the new system.—American Machinist.

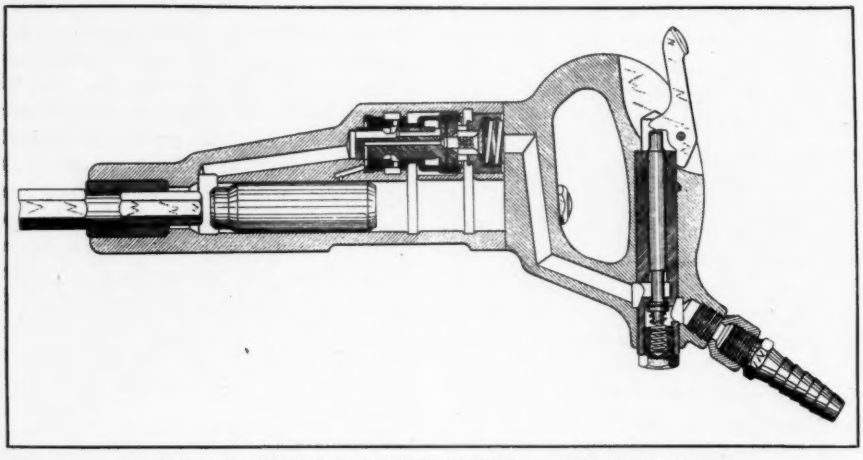


FIG. I—LONGITUDINAL SECTION THROUGH CHIPPING HAMMER.

PNEUMATIC CHISELS FOR STEEL BILLETS*

In spite of the exercise of suitable precautions, such as proper deoxidation of the metal in the open hearth furnace and careful rolling practice in the blooming mill, billets and other steel materials often contain cracks and seams. The only practical method of removing these defects is to employ the chipping hammer. This is done so almost universally that it is surprising that more attention is not given to the cost of the work. As would be suspected, the cost is variable from plant to plant, the following being cogent factors in its determination: (1) cost of labor; (2) cost of moving and shifting steel into position for chipping; (3) cost of inspection; (4) cost of air hammers including depreciation; (5) cost of chipping-chisels; and (6) cost of grinding chisels.

An investigation of chipping was recently carried out in a large steel plant in the central west, and the work resulted in some new departures in practice as well as in a reduction in the cost. The summation of the results of the experiments and the tests is embodied in what follows.

Unskilled labor of the cheapest type obtainable proves to be the best suited for this work. The job of chipping has few attractive features and is highly unpopular with the more intelligent workers of the unskilled labor class. On account of the nature of the work, it is a difficult matter to keep the ranks filled. The constant jar of the hammer is hard on the men and the stooped-over position necessitated by the work is tedious, so that the men, as a rule, are either continually quitting or asking to be transferred to another department. There appears to be no way by which the method of chipping may be altered and still accomplish the desired results. Some slab-yard foremen are of the opinion that the problem cannot be solved. That the cost of chipping can be reduced, however, is borne out by the results of tests.

As already stated, the job is a hard one,

*Condensed from Iron Trade Review.

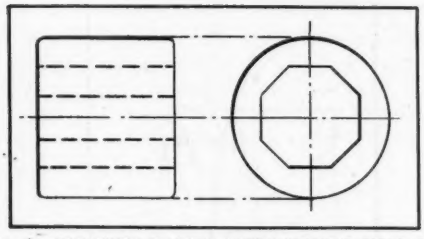


FIG. 2—OLD TYPE OF TWO-PIECE NOZZLE USED IN AIR-HAMMER.

and chippers will avail themselves of the slightest excuse to stop work. Investigation shows that most of the time lost arises from chisel breakage, or, in general, defective chisels. The labor cost is a more or less fixed item, but will vary with the amount of work to be done and the efficiency of the chipping gang. Fig. 1 shows a longitudinal section through a hammer brought out by the Ingersoll-Rand Co., New York, for heavy chipping purposes. This type of hammer was used at the plant under discussion and gave satisfactory service. There has since been a slight change of design in the nozzle which takes the chisel shank, as illustrated in Figs. 2 and 3. Fig. 2 illustrates the nozzle for holding octagonal shank chisels, and Fig. 3 shows the nozzle for holding the conical shank chisels. The latter is more satisfactory than the former. The air consumption per hammer is 19 cubic feet per minute. The cost of air varies from plant to plant, depending on the type of air-compressor and the cost of generating steam.

CARE OF HAMMERS

In order to keep air-hammers in good working condition, they should be properly cleaned and oiled at frequent intervals. For lubrication, a small amount of clean, light machine oil should be poured into the inlet of the handle; when the tool is being used constantly, this should be done every two or three hours. A thick oil should not be used as it causes the moving parts to work sluggishly. For cleaning, the hammer should be taken apart at least once a week, and the parts washed in kerosene.

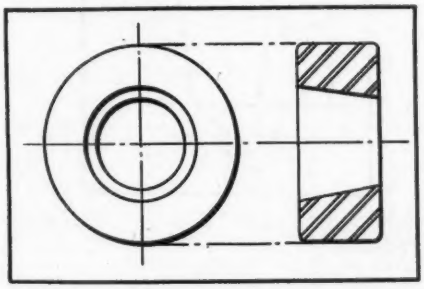


FIG. 3—NEW TYPE OF TWO-PIECE NOZZLE USED IN AIR-HAMMER.

THE CHISELS

The cost of keeping chippers supplied with good chisels is high at best and will be higher unless care is exercised in their treatment. Any investigation of chipping cost with a view to reducing it inevitably leads to a consideration of the chisel itself. The first cost of chipping chisels varies within wide limits according to whether alloy steel or straight carbon steel is employed, and to whether conically tapering or octagonal shanks are used.

A typical steel for chipping chisels at one plant analyzed as follows: Carbon, 0.70 to 0.90 per cent.; sulphur, 0.035 per cent.; phosphorus, 0.015 per cent.; and manganese, 0.20 per cent.

Each chipper needs from six to 12 chisels on hand at all times. Regardless of the shape of the shank, it is worthless if it does not fit the hammer nozzle. Where chisels are used in large quantities, as where 50 or more chippers are at work, it is found economical to have the shanks machined outside at contract prices. Forging, shaping and heat treatment are best performed in the plant, because of the necessity for having a repair man on chisels most of the time. The forging and shaping of the cutting end may be done by a tool blacksmith, but heat treatment should be entrusted to more capable hands and executed under close pyrometric control.

Chipping chisels are short lived because of the severe service requirements and because of the rough treatment they receive at the hands of chippers. To stand up successfully under this hard usage, the steel should be put in the best possible condition. No rule-of-thumb heat treatment is effective, and the results of tests conducted unmistakably demonstrate the superiority of chisels treated under pyrometric control. Experience has shown that straight 0.70 to 0.90 per cent. carbon steel is well adapted for chipping chisels. The chisel point should be of such hardness that it will do the work without breaking off by reason of excessive hardness or yet bend

or "dub" over on account of softness. The shank of the chisel, which fits into the nozzle of the air hammer, must also be treated to stand up under the work. It cannot be so hard as to break off through the shock of pounding or yet so soft as to flow under the repeated blows and accordingly become sufficiently wedged to break the nozzle.

HEAT TREATMENT

A number of experiments were carried out at the plant already mentioned for the purpose of developing a judicious rationale of heat treatment. Previous to the solution of the problem, the chisels were dressed up by the tool blacksmith and given a so-called heat treatment. The latter was conducted by ill-advised, haphazard methods. Strange results followed, as would be expected. One chisel would perform excellent work, while the next dozen or so would be worthless, either so hard as to break off or so soft as to bend over. On an average, 300 chisels were being dressed and heat treated daily.

The experiments for a time showed only negative results, as is usually the case, but a suitable treatment was finally devised. Chisels of 0.80 per cent. carbon steel were heated to 735 degrees Cent. (1,355 F.), or just through the critical range, in a gas fired muffle furnace having uniform temperature. Fifty chisels were charged at once and allowed to soak until a pyrometer rod in the middle of the pile showed 735 degrees Cent. When up to heat, the chisels were quenched by immersing the point about an inch and a half in water. The strains induced by this drastic quenching were relieved, and the resultant hardness mitigated somewhat, by drawing the chisels at 250 degrees Cent. (482 F.) in a bath of high-flash quenching oil. This drawing temperature was discovered by trial of the chisels. Lead baths for heating the chisels before the quenching are preferable.

The foregoing treatment proved rapid and effective; a uniformity of product was secured not possible by any haphazard process. The consumption of chisels was cut down considerably and after the system was placed in working order only 50 chisels, on an average, required heating and dressing per day. The improved method showed a saving of at least $3.90 per day, and if the depreciation charges were added a larger saving would be apparent.

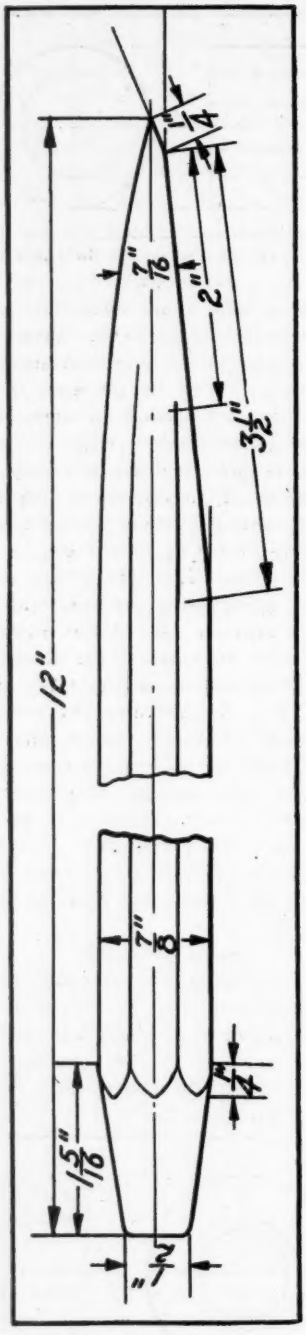


FIG. 4—HALF-ROUND CHISEL OF CORRECT DESIGN.

GRINDING

A great deal of trouble with chisels, as well

as with other tools, arises from ill-advised grinding methods. Heat treatment has been emphasized as an important operation; nevertheless, correct grinding is fully as essential. The damage caused by improper grinding comes from heating the steel and thus undoing the preceding work. The steel is injured by "drawing the temper," which really means that sorbite and pearlite are formed as the critical range is approached. Checking and surface cracks also are formed by the sudden rise in temperature of the thin outer skin of the steel. For hard carbon chisels, grinding wheels of fine grain are recommended. The pressure during grinding should be light, so that the steel is not blued or burned. Strictly speaking, chipping chisels should be ground by a competent tool room man. The economy of such a course over having every chipper grind his own chisels is apparent.

Another cause of the short life of chisels is the unnecessary abuse on the part of the chippers. This element is always present whenever new men are broken in for the job. The chief trouble lies in the fact that most chippers seem bent on ramming the tool down into the steel, to force it to bite, and then bending it over suddenly. The result is that the chisel either breaks off or bends over. Such abuse can be largely overcome by closer supervision over inexperienced men.

DESIGN OF CHISELS

Some of the trouble with chipping chisels is due to faulty design. Several different shapes were tried out in the recently conducted tests with more or less indifferent results. A half-round chisel proved to be the most suitable for the purpose, and the one shown in Fig. 4 was adopted as standard. It should be observed that there is a slight kink or bulge in the curved surface of the back. This throws the cutting edge on a line with the axis, which is both theoretically and practically correct.

COMMERCIAL METERING OF AIR, GAS AND STEAM

In a paper read recently before the Institution of Civil Engineers, (England) Mr. John Lawrence Hodgson discussed the various bases which are suitable for the measurement of compressed air supplied in bulk, and emphasized the desirability of measuring in energy rather than in weight or volume units. The basis of measurement adopted by the Victoria Falls and Transvaal Power Company and by the Rand Mines, Limited, was the quantity of air which would be compressed from mean atmospheric pressure and temperature on the Rand to the pressure of delivery by the expenditure of the energy represented by 1-kw.-hour in an isothermal compression process of the same overall efficiency as that which obtained between the indicated power in the steam cylinders and the air delivered in the case of certain specified compressors then in use upon the Rand; it being understood that these compressors should be put in first-class order for the purpose of the test, and run under normal conditions as regards speed and pressure.

Descriptions were given of the meters and over-load devices designed by the author for use in connection with the Victoria Falls and Transvaal Power Company's air-supply scheme on the Witwatersrand. Two types of meter were used in connection with this scheme; in that supplied to the Power Company a Venturi tube was used, and in that supplied to the consumers a weighted gate placed in the air-way. The more interesting parts of these meters were described; including (1) the arrangements whereby the various factors upon which the energy required to compress the air delivered at each point of supply depends are measured and combined so as to give a counter and diagram record of the energy passing; (2) the bell, which is sensitive to a Venturi head of less than 1-10,000th lb. per sq. in., and which will measure Venturi heads up to 0.85 lb. per sq. in.; (3) the pressure diaphragms, by means of which a powerful movement is obtained from a small change in the pressure; and (4) the air-driven centrifugal escapement by means of which the integrating gear is accurately timed.

Two types of overload device were then described; the one cutting off the flow if the maximum discharge contracted for is exceeded; the other throttling the discharge when necessary, to limit it to the maximum contracted for. These overload devices are so arranged that they can readily be set to cut off or to regulate (as the case may be) at various maximum flows within their range.

The author described the testing plant

which was specially built for calibrating these meters by Messrs. Fraser & Chalmers, and now re-erected at Ferreira Deep on the Witwatersrand, forming the standard air-testing plant for South Africa. Details were given of the large displacement meter which forms part of this plant, capable of passing 1,200 lbs. weight of air per minute, and of the precision manometer by means of which differential pressures can be measured over a large range to within 1-1,000 in. head of oil.

The author went on to discuss the relation between liquid and gaseous discharges through the same nozzle, and showed, for various typical nozzles and orifices, how the gaseous discharge can, under certain conditions, be calculated if the liquid discharge is known. A table was included showing how the economy in the power required for testing meters or wind-resistance models diminishes with the density of the fluid used. The importance of designing the discharge nozzles of "fair shape," if the theoretical discharge formulas are to be used to obtain the discharge, was emphasized. Work on square-edged orifices was carried out by the author in order to obtain an easily reproducible standard of air measurement, but he indicates his preference for the use of round-edged orifices for commercial work on account of their smaller liability to be damaged by erosion or careless handling.

In discussing the difficulties met with in measuring pulsating flows by means of nozzles and orifices, the author submitted tables showing for three typical wave-forms of various amplitudes, and for two different laws of damping, the nature and the approximate amount of the error likely to occur in the measurement.

Other meters described were:—(1) A meter by means of which pulsating flows of any wave-form and amplitude may be accurately measured. (2) A meter designed by the author for general mining work, simple in construction and easily handled, installed and maintained. It can be arranged to register in weight, volume, or energy units, as required. It will measure such pulsating flows as are met with in practice with sufficient accuracy, and it corrects automatically for variations in pressure. (3) A steam-metering instrument designed by the author. (4) A gas-meter which has been successfully used for the metering of large volumes of gas. It will measure down to one-twelfth of full load, and, unlike all other gaseous meters which depend upon a differential pressure measurement, the registration of this meter is independent of the density of the gas passing.

DRILL SHARPENERS FOR SMALL STEELS

The half tones on these pages give us two different views of a drill sharpener which has been specially designed to meet the requirements of the small mine, quarry or contract. It is known as the Leyner Jacksteel Sharpener, and is a small edition, with modifications, of the standard No. 5 Leyner sharpener.

The new machine is designed to handle the small sizes of steel, such as used with jackhamers, stopehamers, plug drills of various kinds and the like. The manufacturer limits its capacity as follows: Steel sizes: 1 1-8 maximum diameter round, cruciform, and light section twisted or banded steel; 1-in. maximum diameter hexagon or octagon steel; 7-8-in. maximum diameter square steel.

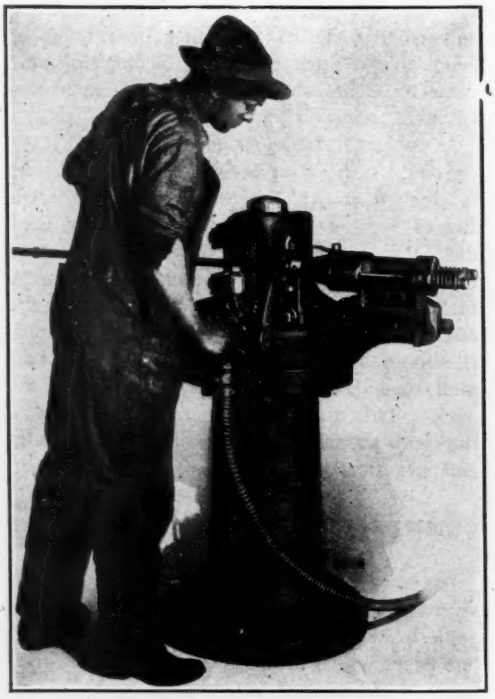


FIG. I.

FIG. 2.

Bit sizes: 2-in. maximum diameter 4, 5, 6, point, Z, X and single or double chisel bits of standard 14-degree taper; 1 7-8-in. maximum diameter "Carr" or bits of other than 14-degree taper. Shanks also can be made on the smaller sizes of steel by the usual Leyner method.

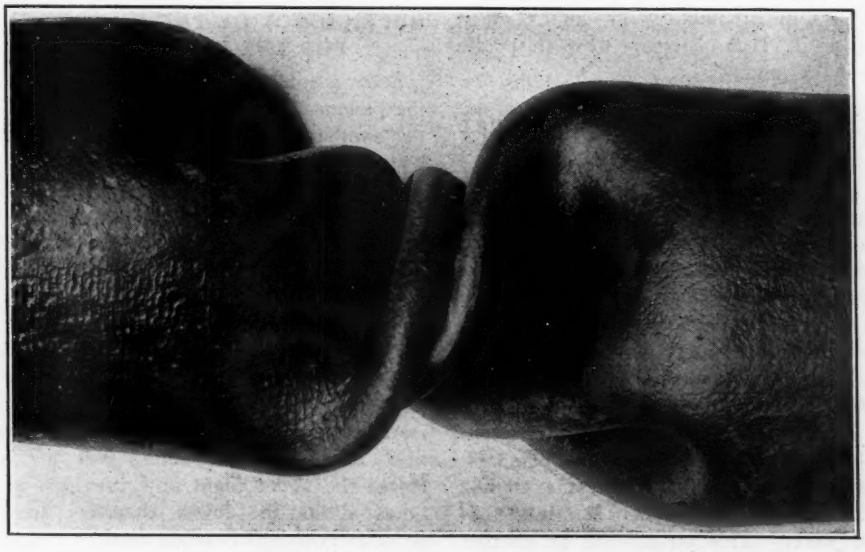
An unusual feature is the employment of a single piston rod on the clamping piston. This allows the Leyner die and dollying hammer to be so located as to operate immediately under the eye of the operator. This advantage of complete visibility of the entire operation is stated to be of prime importance in securing the best possible grade of work.

An entirely enclosing die is employed, as with the large Leyner sharpener, in which the metal of the bit is thoroughly compacted by the dollying hammer. The completion of the sharpening operation within the die effects the same absolute correctness of gage and exact duplication of bits of any gage. A single lever (under the operator's hand in Fig 1) controls both clamping and dollying. This, it is claimed, conserves the muscular effort as well as the time of the operator.

The machine weighs 925 lb. No special foundation is required. Made by Ingersoll-Rand Company.

A TWIST IN NATIONAL TUBE

The excellent photo here reproduced shows a mechanical curiosity of the present day which would have been an impossibility not so very long ago. It is not rubber, molasses candy, soap, putty or any such yielding substance, but as far from it as possible. It is a piece of 8 in. National Line Pipe which



has been subjected to a torsional stress of 713,000 inch pounds. This pipe is about 3-8 in. thick and weighs 29 lb. per foot. The specimen shows not the slightest sign of cracking or tearing, which indicates the wonderful properties of the metal.

THERMALINE

Thermaline is a gas, the discovery of which was recently announced from Zurich, Switzerland. It is used for welding and cutting in the same manner as acetylene is used with oxygen. It is produced by the decomposition of calcium carbide with water and is enriched or compounded with the heated vapors of crude oil. There are several claims made for it. It is heavier than air, specific gravity 1.1, and it is said it can be used at a lower pressure than the other gases. It is not explosive when liquefied, and its explosive range is narrow; the explosive ratio is from 12 per cent. to 30 per cent. air. It can be liquefied at a pressure slightly over 1,400 pounds and at the ordinary atmospheric temperature. An excess of oxygen is not required in the welding flame, so that there need not be any reduction of the carbon in the iron or steel which is being welded, thus producing a soft weld. It is generated automatically in a portable apparatus as needed and delivered to the torch at 15 pounds pressure. The special feature in its production is the use of cartridges of material, consisting of alternate layers of calcium carbide and sawdust soaked in oil. It is necessary to wash, purify and cool the gas.

THE BEGINNING OF MECHANICAL REFRIGERATION

The original air refrigerating machine was brought out in 1845 by Dr. Gorrie of New Orleans, who with Dr. Cullen felt a special need of artificial refrigeration in the aid of his profession. This mechanism had a cylinder in which the air was first compressed. It was passed from this cylinder to a chamber cooled by running water where a pressure of fifteen pounds per square inch above that of the atmosphere was maintained. The air was already cooled partly during compression by the injection of water, the cooling chamber receiving in reality a mixture of air and water. This on passing to another cylinder was expanded down to something like atmospheric pressure. While expanding it was mixed with brine injected into the cylinder, the low temperature of the expanding air communicating itself to the brine. The air on leaving this cylinder was allowed to escape to the atmosphere while the brine, now cooled to 20 deg. F., was conveyed into a tank and applied to ice making.—Edison Monthly.

GAS FOR INCUBATORS

In a Pacific Coast Gas Assn. wrinkle, Henry Bostwick says that among the experiences that have come to them in the way of supplying gas in the industrial field was that of the poultry business. "Here I find a large volume of our product being used for incubation and brooding of young chicks. While this is not new, yet I doubt if anyone has a rightful appreciation of what it does mean, or may mean, to a supplying company. The representative of one of the gas concerns in California informs me that in his district there is a monthly consumption of nearly 1,500,000 cu. ft. for this purpose alone, one concern using 300,000 cu. ft. This use of gas has displaced other methods, such as oil and electricity, and gas was found to be most reliable and economical. He assures me that the consumers have been making a saving of from 25 to 30 per cent."—Gas Age.

SUFFICIENCY OF THE WATER SUPPLY FOR THE PANAMA CANAL

From a study made of the water supply for the Panama Canal it has been ascertained that an average of 7.21 million cubic feet of water was used for each through lockage from ocean to ocean; that an average of 12,787.47 million cubic feet of water was wasted over Gatun spillway, or a sufficient quantity of water to make 1773 through lockages each month. Based on 30-day operation, this would mean 59 lockages per day over and above the average traffic for the past year. According to the latest annual report of the Governor of the Panama Canal, the maximum number of lockages which can be made in 24 hours is 48, assuming that one vessel leaves the upper flight at Gatun just as another enters the lower chamber, and *vice versa*, both chambers being used.

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EVERYTHING PNEUMATIC

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WHERE WE ALL STAND

We are at the beginning of an age in which it will be insisted that the same standards of conduct and of responsibility for wrong done shall be observed among nations and their governments that are observed among the individual citizens of civilized states. We have no quarrel with the German people. We have no feeling toward them but one of sympathy and friendship. It was not upon their impulse that their government acted in entering this war. It was not with their previous knowledge or approval. It was a war determined upon as wars used to be determined on in the old unhappy days when people were nowhere consulted by their rulers and wars were provoked and waged in the interest of dynasties or of little groups of ambitious men who were accustomed to use their fellow men as pawns and tools.—WOODROW WILSON.

AIRPLANES AND SUBMARINES

We as a nation are now committed to war, with all that the word embodies, and what may be our experiences none can foretell. Of one thing only we may be certain, and that is the seriousness of it. The animus of war has not changed; it still, as always, means slaughter and destruction by all the means available. Like all other of human activities, it has developed from the retail to the wholesale and avails itself of all the modern facilities of efficiency, so that now we can kill and scatter desolation as in the earlier days was never dreamed of, and our only safety and promise of success is in the wise and strenuous employment of all the means which, strangely enough, the years of peace have developed.

The agencies and methods most prominent and most potent in modern warfare are of very recent development, and in all particulars are as far as possible from the weapons offensive and defensive which war through all the ages has wielded and trusted. The Prince of the Power of the Air dominates the situation. The Airplane in the sky and the air propelled torpedo in the deep are now the supreme arbiters of fate. It would now be difficult to over-estimate the importance of the aviator and his equipment. Land warfare cannot be successfully conducted and deciding victories cannot be won without him.

The supreme importance of the airplane being so evident, the thing for us to do is to put into the air a larger number of better machines, with better men to drive them, and above all to get them in the quickest time. Even if supremacy can be attained, it can only be maintained while the strife continues by constant increase in numbers, constant and instant adoption of every improvement, constant increase in the number and the efficiency of aviators and observers. So far as can be seen by the public it would seem that aviation is not getting with us, indeed is far from getting, the urgent drive behind it which the case demands.

The submarine, the submersible, and their supreme weapon of offense, the torpedo, are both compressed air creatures and have brought with them novel problems still demanding solution. The world appalled has to confess that no man has yet devised the means and methods of surely dealing with them. Their essential condition for successful action is in their practical invisibility at ordinary distances and their total disappearance when desired. The one way to cope with them would seem to be in the adoption of the same features in opposition. The submarine may be the only monster to oust the submarine, but the crews for such craft should be ultra-human.

NEW BOOK

Compressed Air for Metal Workers. By Charles A. Hirschberg, 330 pages 8 1-4 by 5 1-2 inches, 294 illustrations, 30 tables. New York. Clark Book Company, $3.00.

This is an eminently practical book, embodying precisely the information most required by users of compressed air and passing more lightly over the theories which appeal to the scientist. It deals principally with dimensions, capacities, costs of operation, etc., giving numerous tables of authoritative data. Descriptions and illustrations of a great variety of air compressors and their appurtenances are presented, and the tools and apparatus using compressed air for their motive power are dealt with copiously. The entire range of metal working in which compressed air is employed seems to be covered although the reach is astonishing. A large portion of the book will of course appeal to those who cannot be classed as metal workers. The matter is systematically arranged and completely indexed.

BY-PRODUCTS OF METALLURGY

Few laymen realize the great impetus given to the metal industries during the past few years by the development and use found for what was formerly discarded as waste. No longer satisfied with obtaining the principal obvious values found in the ores, smeltermen are now realizing—and acting upon their realization—that, as in the packing industry, the real profit of the future will be found in the side lines. It has been rarely found that a proper amount of investigation and research has not opened up some new field of usefulness for what was previously thrown away, and in some cases the new field of use for the by-product has completely overshadowed the former use of the main product. Investigation of the possibilities of such by-products is perhaps the most inviting and promising field in metallurgy today.

Take the case of gasoline. It has not been so very many years ago that kerosene was the principal standby of the oil refineries. They were diluting the kerosene with as much of that troublesome mixture called gasoline as they dared, and were spurring their investigators on to find some way to dispose of the rest. Then the automobile and the general application of the gas engine arrived on the scene hand in hand, and presto! the whole situation has changed. Now as much kerosene as possible is being added to gasoline, and they are busy inventing and trying out new ways to get more of that indispensable fuel out of the same amount of raw oil.

It is not so very long since the total slag from iron blast furnaces was run to waste. Then it was found that with little extra expense, an excellent grade of Portland cement could be made, and a considerable part of it is now so used, although much is still wasted. Slag from the copper blast furnace has not yet found its field of usefulness, although some attempt has been made to form tile and blocks for paving and similar uses out of it. Several railroads are said to express a decided preference for it as ballast, since, on account of its hardness and sharpness, it discourages travel along their lines, by holders of "tie passes."

Arsenic, the half sister of sulphur has also yet to find a large field for use. It is found very widely in nature, and forms an undesirable and many times prohibitive ingredient of certain ores, and is often penalized in copper ore. Arsenic is valuable to decolorize glass, to make certain paints and colors, and is also an important ingredient in many of the sprays used on trees. The total consumption forms only a small part of the amount available. Anaconda alone could probably supply the entire demand in this country. As a matter of fact the Tacoma smelter supplies a considerable fraction of the total production from the ore received from one mine.

Cobalt is another weak sister of the metal family. Having many of the characteristics of nickel, and usually more or less associated with it, Cobalt has shown no such usefulness in the manufacture of high grade steel, nor in alloys. Its principal demand was very limited for colors, for some chemical preparations, and in similar limited uses. Within the last few years, however, an American inventor has succeeded in making an alloy of cobalt and chromium that is so infusible that it can not be melted in any ordinary manner, so hard that it cannot be cut in any way. This alloy promises to be of very important use for cutting tools, as points for sparks plugs, battery points and many other different ways.

A Portland cement plant in California found itself confronted by many damage suits commenced by farmers of the vicinity because of a fine dust pouring from their stack, which settled on the adjacent lands. A Cottrell electrostatic dust precipitation apparatus, the invention of a metallurgist in the service of the Bureau of Mines, was installed, and this caught and settled the dust. A little investigation showed this to be high in potash, and further research enabled them to make a good potash fertilizer out of it. The people who were sueing for the damage done by the dust are now paying high prices for the fertilizer made from it.

One of the most interesting cases of the widening usefulness is in copper smelting. A few years ago the sulphur fumes were not only wasted, but also large amounts were paid out in damages for injury to vegetation. So common was this sort of complaint, and so lucrative its reward in the courts that a regular trade known as "smoke-farmer" sprung up. Then many smelters erected acid plants which recovered a great part of this fume to make sulphuric acid. The demand for high grade acid being comparatively limited, a market was sought for the large quantities of the cheaper product. Copper and zinc leaching developed hand in hand with flotation, and each required its share of the acid, but most important of all was the use in flotation. The development of flotation process has also created a demand for cheap wood, coal and certain mineral oils. This has enabled wood oil manufacturers, gas works and oil refineries to dispose of what had previously been either waste or at best a low priced by-product. This in turn is causing coking plants to consider by-product ovens in their new installations, instead of the old wasteful beehive type, by which nothing was saved. In saving the oil, moreover, more or less ammonia and other products are also recovered, valuable for nitrates and other purposes.

Further, flotation concentrates usually require roasting before they are smelted, and this fume is especially used in making the acid so necessary in recovering the concentrates in the first place. At Anaconda and Utah are very large plants, as elsewhere throughout the country, while over at Tacoma an experimental plant is making liquid sulphur dioxide for bleaching and other purposes, also native sulphur. An acid plant may also be the next development there.

An interesting indication of the thoroughness of the way that these things are being worked out is the fact that at Anaconda, the slime tailing from the flotation plant was found to be very high in alumina, suitable for making fire brick. An excellent quality of pressed brick is now being produced as a result. Thus even the squeal being extracted from the pig in metallurgy if not in the packing business.—Alaska and Northwest Mining Journal.

Reports from Pennsylvania state the famous test well, on which the eyes of the oil world have been centered the past several months, is now down to 7,800 feet, and the drill is still being pushed downward. The well now holds the record for deep wells, exceeding the famous well of Rumania by 500 feet. The well has cost more than $100,000 to date.

NOISELESS FOGHORNS

BY R. E. NEALE

The idea of a noiseless foghorn may seem about as useful as an alarm clock which will not ring. Nevertheless, there are at least two *possible* ways in which a noiseless foghorn may be provided, and, of these two methods, one is already practicable. Indeed, it is already in use. The noiseless foghorn which is already in use, employs electromagnetic waves in the ether—*i. e.*, it is a special application of wireless telegraphy. The noiseless foghorn which is *possible* but not yet practicable would supply vibrations of very high frequency in the air. The sounds we hear are the impression conveyed to our brain by vibrations in the air falling upon our ears. As the frequency of those vibrations is increased (*i. e.*, the distance from crest to crest of the air waves is reduced) we come to a point beyond which our hearing organs fail to respond to the vibrations. So far as we are concerned, there is then silence, but actually the vibrations are just the same as before, except that their frequency or "pitch" has been increased. We have, in fact, a "soundless" sound—a sound which cannot be heard by our ears because of the limitations of their construction and action, but a sound which may quite likely be audible to some other living creatures, and which may be rendered apparent to us if we can only discover a suitable detector.

The "atmospherics," so familiar to every wireless experimenter, have doubtless been going on for countless ages past, yet no one perceived them (much less considered the possibility of generating similar oscillations and using them for signalling purposes) until Hertz devised his simple detector, which was the first parent of all modern radio-telegraphic-receiving apparatus. Some little time before Hertz discovered how to detect what we now call wireless waves, Maxwell had predicted the existence of the latter by his remarkable application of mathematics to physics, but he did not know how to prove the correctness of his conclusions by actually making the electromagnetic waves of these frequencies apparent to human senses.

As regards air waves of very high frequencies, we are now in much the same position as Hertz was before he discovered his radio-detector. None of the human senses is directly sensitive to "wireless" waves, and none is directly sensitive to very high frequency air waves. We know that wireless waves exist, and we know how to produce and apply them; but whilst we know that very high frequency air waves may exist, we do not yet know how to produce them or how to detect them if they are already existent. Once we have solved that problem, we shall probably have another means of transmitting signals, at any rate, over moderate distances, and one very promising application would be in the form of a noiseless syren or foghorn for use between ships at sea or between aircraft in flight.

The noiseless foghorn which we have already at our disposal by suitable application of radio-telegraphy, depends upon the fact that certain shapes of aerial give out "lop-sided" signals—*i. e.*, radiate electro-magnetic waves more powerfully in one direction than in another. Conversely, such aerials pick up signals from certain directions more effectively than from others, so that by turning the aerial we can either send out a specially strong signal in any desired direction, or we can tell fairly accurately the direction from which a certain signal is coming. Obviously, both these possibilities are very useful in connection with signal stations on dangerous parts of the coast and for use on vessels moving through fog, but it would be very inconvenient actually to have to move the aerial. Fortunately, the same result can be obtained by purely electrical means. For instance, by using two aerials at right angles, and varying electrically the distribution of energy between them, we can obtain the same radiating effect as would be given by a single aerial at some intermediate position. In other words, we can control electrically the direction of maximum radiation from, or maximum reception by, the compound aerial, and thus send out a specially strong signal in any desired direction, or tell from what direction a received signal is proceeding.

DUST IN EXPLOSIVE MIXTURES

The fact that coal-dust is explosive is very generally known to-day, though only within the last thirty years has it been fully recognized that coal dust alone is explosive without the presence of gas. Experiments have shown

that many other carbonaceous dusts are at least as easily ignited and capable of propagating an explosion as coal-dust. While most of the dust explosions reported in surface plants occur in mills and elevators handling wheat, oats, and corn and their products, it appears that no mill handling carbonaceous material is immune from the possibility of explosion. The list of known explosions in other kinds of mills includes those handling dextrine, sugar, starch, malt, wood, linseed meal, cottonseed meal, paper, cork, fertilizer, sulphur, cocoa, and spice dusts.

That flour dust will explode was clearly demonstrated in 1878 by a tremendous explosion in the Washburn Flour Mills in Minneapolis. This disaster aroused milling men to the danger of existing conditions and caused many to take immediate precautions against a repetition of a similar occurrence. The impression was not lasting, and, although a large number of grain-dust explosions occurred later, general interest was not awakened until June 24, 1913, when an explosion occurred in a feed-grinding plant at Buffalo in which 33 men lost their lives and over 70 men were injured. This explosion, which occurred during the ordinary process of milling, completely destroyed the mill and considerably damaged the surrounding property. As a result, an agitation was started between the millers and the Bureau of Mines for the investigation of questions relating to explosions of grain dust. This was later taken up by the Government and is being continued in cooperation between the Bureau of Chemistry and the Bureau of Mines.

LIQUID GREASE FOR LUBRICATING DRILLS

In an article on "Lubrication of Rock Drills" in our April issue, page 8333, several brands of liquid grease were mentioned as suitable for drill lubrication. As the results of later tests several other brands of grease are now considered as good or even better. Among these are to be mentioned the following:

"I R X" Jackhamer and Stoper Grease, Standard Oil Co., No. 6 Keystone Liquid Grease, Keystone Lubricating Co. "B" Absorbed Oil, E. F. Houghton & Co.

HIGH PRESSURE IN PNEUMATIC CAISSONS

In the building of the Paducak & Illinois R. R. Co.'s bridge over the Ohio River at Metropolis, Ill, pneumatic caissons were sunk for the seven river piers. The men worked to an extreme depth of 113 ft., which meant an air pressure of 51 lb. Temperatures also up to 125 degrees F. were recorded in the working chambers. When the conditions were at their extreme of discomfort the shifts were reduced to 3-4 hr. and no serious results developed.

THE SIX METRIC MYTHS

The above is the title of a bulletin issued by the American Institute of Weights and Measures, 20 Vesey Street, New York, and sent free to any address upon request. The myths, which are strongly and convincingly controverted, are as follows:

1. The system is in universal use except in the United States, the British Empire and Russia, and frequently Russia is placed in the metric column.
2. The adoption of the system is easy and the transition period short.
3. There exists a confusion in our weights and measures and the system should be adopted in order to get rid of it.
4. The system leads to an important saving of time in calculations.
5. The system leads to an important saving of time in primary education.
6. The adoption of the system is important in the interest of foreign trade.

NOTES

During the month of November last, according to the report of the Mines Department, there were 9,904 rock drills in commission on the gold mines of the Witwatersrand, but only 6,395 were, on the average, actually in use.

The long abandoned Pond Creek mines, north of Hazleton, Pa., now being opened for the third time, will put into use a number of steam locomotives formerly in service on the New York Elevated Railway.

What is regarded as the greatest percentage of profit ever made from an investment in Oklahoma oil property is reported as made by Samuel A. Apple, Wirt Franklin and Judge

J. W. Harrold. These men attracted by the future prospects of the Healdton field paid $25 for a lease on 100 acres of land in section 9-4-3 and held it for several months. A few weeks ago they sold the acreage to the Sinclair Gulf Oil Company at a price which brought them a little more than $10,000 for every $1 invested.

Paint manufacturers in the United States are uneasy, fearing that some development in the war situation may cut them off from their supply of chalk which is imported to the extent of 200,000 tons annually, and comes largely from Dover, England.

The mount of surface exposed to oxidation in a given mass depends on the size of the particles and increases very rapidly as the fineness approaches that of dust. Dust, therefore, is dangerous in a coal pile, particularly if it is mixed with larger-sized coal which forms air passages to the interior. Spontaneous combustion is brought about by slow oxidation in an air supply sufficient to carry away all the heat formed.

The Wilson Avenue tunnel for the Chicago water supply, 12 ft. in diameter and 8 miles long, is being rapidly lined by the pneumatic process. Four concreting outfits are in use, the men working two 8-hour shifts. In January one outfit mixed and placed concrete in three 30 ft. lengths of forms daily, and on two consecutive days four forms were completed. These 30 ft. forms contain an average of 2 cu. yd. of concrete per lineal foot of tunnel. The pneumatic equipment was furnished by the Concrete Mixing and Placing Company of Chicago.

When a modern large gun is fired with nitrocellulose smokeless powder, the temperature of combustion reaches from 4,000 to 5,000 deg. fahr.; and if the powder contains 25 per cent. of nitroglycerine, it may rise to 5,000 to 6,500 deg. Steel melts at 2,650 deg. fahr., and a thin film of steel is fused in about one-sixtieth of a second. As soon as the projectile has left the gun, the big outflow of gas washes away a portion of this thin film of fused steel, and the bore is thus enlarged 0.001-in. in a 14- or 16-in. gun at each shot. With 58 per cent. nitroglycerine, as in some English powders, the erosion is much greater.—Hudson Maxim.

Based both on theoretical investigations and on field tests, the author of Bulletin 376 of the U. S. Department of Agriculture concludes that wood pipe will convey about 15 per cent. more water than a ten-year-old cast-iron pipe or a new riveted pipe, and about 25 per cent. more than a cast-iron pipe twenty years old or a riveted pipe ten years old.

The altitude of Leadville, Colorado, is 10,200 ft. above the sea at Harrison Avenue; Cripple Creek is about 10,000 ft.; Ouray, 7,710 ft.; Deadwood, South Dakota, 4,530 ft.; Lead, 5,300 ft.; Butte, Montana, at the Court House, is 5,767 ft.; Boise, Idaho, 2,739 ft.; Prescott, Arizona, at the Court House, is 5,346 ft.; Bisbee, 5,300 ft.; Jackson, California, 1,975 ft.; Salt Lake City, Utah, 4,248 ft.; and Park City, 6,222 ft.; Virginia City, Nevada, 6,339 ft. The Alaska Treadwell mines are at sea-level, as are numerous others in Alaska and in British Columbia, while there are valuable mines in the South American Andes, at 15,000 to 18,000 ft. above the sea.

Ear-defenders, designed by artillery-men in Europe, are being tried in stamp-mills on the Rand to lessen the effect of the sound on the ear-drums of millmen. The apparatus consists of two small vulcanite plugs, shaped much like the pawns used in a game of chess, and fitting into the ears. A hole is made through the length of the pieces, and at the enlarged bell-mouth end a fine wire-screen is fixed. This screen breaks the waves of sound. At the Knights-Deep mill (120 stamps) it was considered that a broken stem or any unusual noise was more easily detected when wearing the defenders. Also, hearing becomes normal quickly after leaving the plant. The use of cotton-wool in the ears is not always safe, sometimes causing obstructions later on.

It often happens that the gas supply in city mains is at a too high pressure to be used with economy in gas stoves, and in any case there is danger of using considerably more

gas than is really needed, so that a device for reducing the pressure will prevent waste of gas in quite a number of cases. A simple device of this kind has one end connected by hose to the mains, while the gas comes out of the other end and goes by a second hose to the burner. Between the high and the low pressure sides is placed a partition containing a set of fine holes, so that the gas can only pass through at a reduced rate, and this is found to lower the pressure very effectively.

1,218,149. ROCK-DRILL. James C. Wright, Colorado.

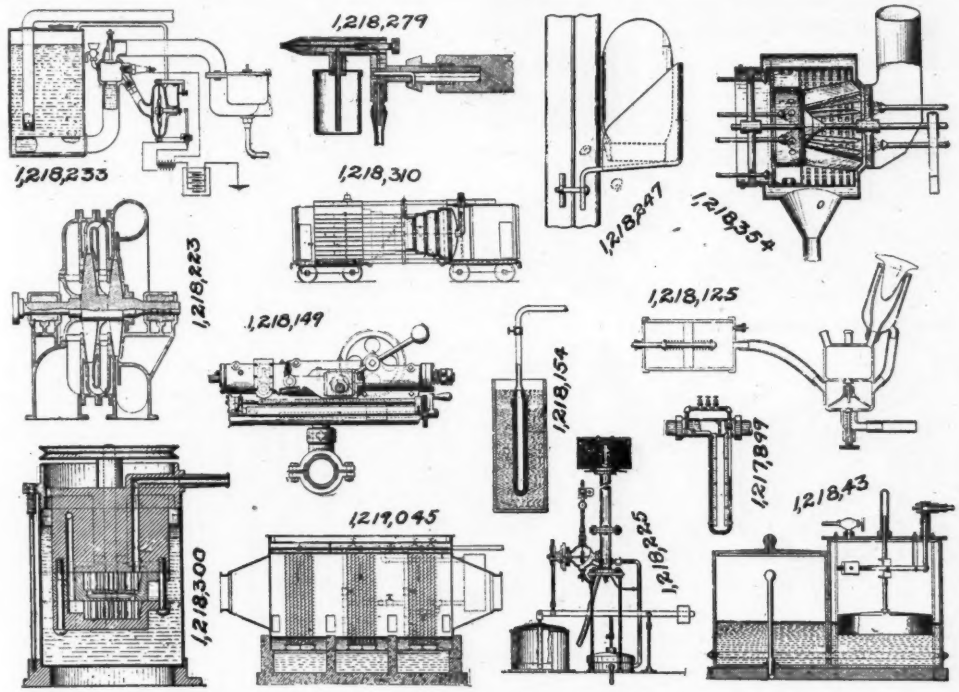
1,218,154. METHOD OF TESTING FILTER-BODIES. Edward Zahm, Buffalo, N. Y., assignor to Zahm Manu

The hereindescribed method of testing a porous filter body for determining the size of the pores therein comprising wetting said body so that the interstices are liquid sealed and then subjecting the same to gas pressure and determining the pressure at which the seal is broken.

1,218,223. CENTRIFUGAL BLOWER. Charles H. Smoot, New York, N. Y.

1,218,225. SIGNALLING APPARATUS. Chas. Alexander Stevenson, Edinburgh, and John Moyes, Glasgow, Scotland.

1. An apparatus of the character stated, comprising, in combination, an explosion cham-



PNEUMATIC PATENTS MARCH 6

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MARCH 6.

1,217,899. METER FOR STEAM, AIR OR OTHER GASES. George Hale Barrus, Brookline, Mass.

1,217,901. FLUID-PRESSURE-REGULATING VALVE. Charles L. Bastian, Chicago, Ill.

1,218,045. AIR-CONDITIONING APPARATUS. Harry Bentz, Montclair, N. J.

1,218,125. MILKING-MACHINE. David Townsend Sharples, West Chester, Pa.

1,218,134. VACUUM-CLEANER. Hugh C. Tyler, Columbus, Ohio.

ber, pulsating apparatus adapted to supply gas periodically thereto, means, operable from the pulsating apparatus, for supplying air periodically to the explosion chamber, an ignition device for effecting the ignition of the mixture in the explosion chamber, and means for periodically operating said ignition device from said pulsating apparatus.

1,218,233. PRESSURE-GENERATING DEVICE. Fred S. Welch, Pontiac, Mich.

1. In a sprayer, the combination of an air tight tank, liquid therein, a combustion chamber, said combustion chamber communicating with said tank below the liquid level therein, and means for causing explosions in said chamber whereby the gas is transferred under pressure from said combustion chamber to said tank.

1,218,247. HUMIDIFIER. John E. Dutcher, Chicago, Ill.

1,218,279. AIR-BRUSH. August Kopinski, Chicago, Ill.

1,218,291. COMBINED AIR AND STUFFED CUSHION. Christian W. Meinecke, East Orange, N. J.

1,218,300. VACUUM-PUMP. George F. Nelson, Berkeley, Cal.

1,218,310. PNEUMATIC-DYNAMIC CAR FOR DIMINISHING THE DESTRUCTIVE EFFECTS OF RAILROAD COLLISIONS. Pasquale Penza, Bologna, Italy.

1,218,354. PROCESS FOR THE SEPARATION OF DUST PARTICLES AND SMOKE FROM AIR AND GASES. William J. Baldwin, Brooklyn, N. Y.

1,218,446-7. MILKING-MACHINE. Mark J. Murphy and Harry H. Brandeau, St. Paul, Minn.

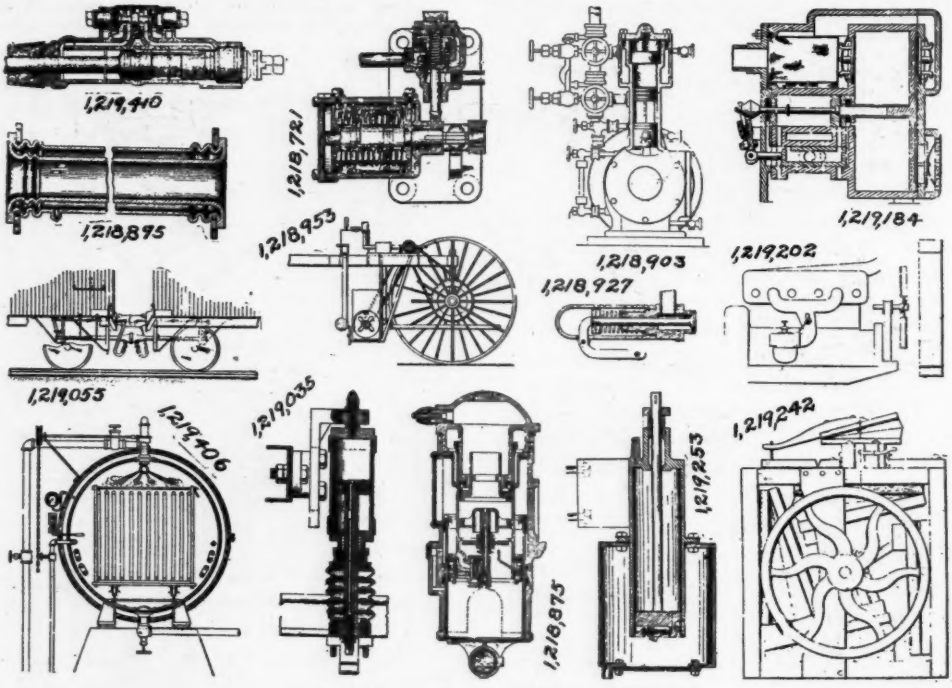
strains at the points of union between the inner and outer walls of the duplex casing.

1,218,903. COMPRESSOR. John C. Scovel, Jr., Chicago, Ill.

1,218,927. FOOT AIR-ACCELERATOR FOR HYDRO-CARBON-MOTORS. Ernest Bussey, Dothan, Ala.

1,218,953. SPRAYING AND POWDER-DUSTING ATTACHMENT. Frank Oldham, Dallas, Tex.

1. In a spraying and powder dusting attachment, a base plate adapted to be mounted on a wheel supported frame of a cultivator, an air compressor mounted on the plate, a liquid tank connected with the air compressor, a hanger carried by the plate, a powder dusting hopper



PNEUMATIC PATENTS MARCH 13

1,218,543. GAS - PRESSURE REGULATOR. Bernhardt Mathias Gattermeir, California, Mo.

MARCH 13.

1,218,721. TRIP-VALVE DEVICE FOR AIR-BRAKES. Walter V. Turner, Edgewood borough, Pa.

1,218,875. VARIABLE-LOAD AIR - SPRING. Richard Liebau, Swissvale, Pa.

1,218,895. PIPE FOR THE CONVEYANCE OF FLUIDS. Edwin H. Porter, Philadelphia, Pa.

1. An integral unit for pipes for conveying fluids with a minimum of heat transference between the interior bore or passage of the pipe and the exterior, comprising a duplex tubular metallic casing having imperforate inner and outer walls inclosing an exhausted or vacuum annular space extending substantially throughout the length thereof, said walls being united at the ends into a single wall, and having corrugations adjacent the union of the walls at each end to accommodate the variations in the expansion of the walls and relieve the

carried by the hanger and having provision for dusting powder, and a nozzle carried in advance of the hopper and connected with the tank.

1,218,991. COMPOUND APPARATUS FOR CASTING METALS IN VACUUM. Erminio Ferrari, Venice, Italy.

1,219,035. SHOCK - ABSORBER. Ralph H. Pettengill, Haverhill, Mass.

1,219,055. AUTOMATIC AIR-COUPLING DEVICE FOR RAILWAY-TRAINS. Claud L. Turner, Perry E. Whitehead, and Sye C. Clarke, Gering, Nebr.

1,219,104. PNEUMATIC DEVICE FOR PLAYER-PIANOS. Charles V. Jameson, Chicago, Ill.

1,219,121-2-3-4-5. AIRSHIP OR DIRIGIBLE BALLOON. Thomas Rutherford Macmechen and Edwin Marshall Fox, Westminster, London, England.

1,219,184. HYDRAULIC MOTOR-DRIVEN AIR EXHAUSTER AND COMPRESSOR. Stanley M. Stone, New York, N. Y.

1,219,202. AIR-REGULATOR FOR ENGINE-MANIFOLDS. Emile Waldmeier, Gulport, Miss.

1,219,242. FOUR-WAY VACUUM-PUMP. Paul I. Burks, Louisville, Ky.

1,219,253. AIR RAILWAY-BRAKE. Samuel Cheney, Wickepin, Western Australia, Australia.

1,219,388. ART OF IMPREGNATING TIMBER AND OTHER MATERIAL WITH A PRESERVATIVE. Oliver P. M. Goss, Seattle, Wash.

1. In the preserving treatment of porous material, the method which consists in first heating the material in a bituminous preservative, in a close container, to approximately 230 degrees Fahrenheit under normal pressure, then drawing a vacuum of approximately 15 to 28 inches in the container and maintaining the heat of the latter at a temperature above that of boiling water under said vacuum for not less than half an hour, then breaking such vacuum, and applying pressure sufficient to force approximately from five to twenty pounds of the preservative fluid into the pores of each cubic foot of material.

1,219,391. HUMIDIFIER. Hugh S. Grigsby, Richmond, Va.

1,219,406. PROCESS OF DRYING AND EXTRACTING. Daniel B. Banks, Baltimore, Md.

1,219,410. PRESSURE-ACTUATED VALVE. Frank E. Willey, Claremont, N. H.

MARCH 20.

1,219,477-8. DRILL-SHARPENER. Edward L. Oldham, Denver, Colo.

1,219,498. OPERATING MECHANISM FOR ROCK-DRILLS. William A. Smith, Denver, Colo.

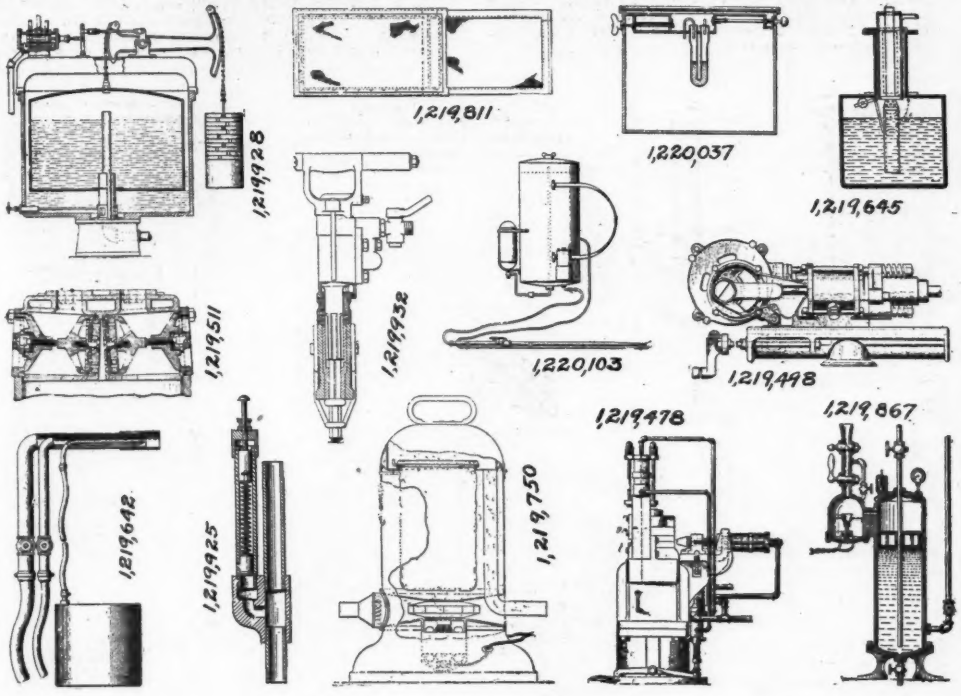
1,219,511. AIR-COMPRESSOR. Carl W. Weiss, Brooklyn, N. Y.

1. In combination with a cage, a valve unit carried on the cage and composed of a seat, a plate valve and a guard, said seat being invertible and the seat and the guard being interchangeable in position relative to the cage without disturbing their operative relation to the plate valve whereby the valve may be caused to act either as an inlet or outlet valve with said cage.

1,219,606. BRAKE-CYLINDER-PRESSURE REGULATOR. Walter V. Turner, Edgewood, Pa.

1,219,642. SPRAYER. Joel L. Isaacs, Chicago, Ill.

5. In an appliance of the character described, the combination of a duplex nozzle adapted to deliver a coating material under pressure in the form of a spray, and means to deliver a tube of compressed-air under greater pressure surrounding and confining said spray, substantially as described.



PNEUMATIC PATENTS MARCH 20

1,219,645. METHOD OF PRODUCING BLASTING CHARGES IN WHICH LIQUID AIR IS USED. Ambrose Kowastch, New York, N. Y.

1,219,710. VACUUM CASTING DEVICE FOR GOLD-INLAY WORK AND THE LIKE. Frank B. Davis, Johnstown, Pa.

1,219,723. PNEUMATIC ALARM SYSTEM. Frank T. Gracey and Thomas W. Lander, Eddyville, Ky.

1,219,756. VACUUM-CLEANER. Hubert Meredith Jones, New York, N. Y.

1,219,811. AIR-PURIFYING AND VENTILATING DEVICE. William D. Doty, Streator, Ill.

1,219,867. PRESSURE-PRODUCING APPARATUS. William J. Reilly, Denver, Colo.

1,219,925. AUTOMATIC VALVE FOR INFLATING TIRES. Franklin A. Dean and William H. Little, Alta Vista, Kans.

1,219,928. FLUID-PRESSURE GOVERNOR. Ralph C. Enyart, Connersville, Ind.

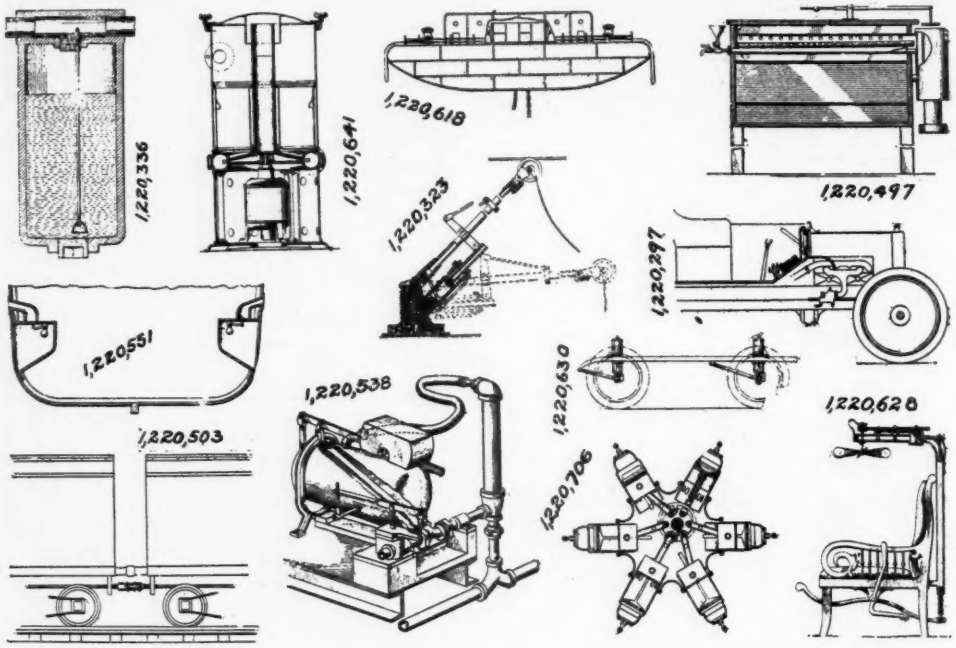
1,219,932. PNEUMATIC TOOL. Norris H. Frost, West Hoboken, N. J.

1,219,970. PROCESS FOR CONVERTING STEAM HEAT OF A LIQUID INTO MOTIVE FORCE. Karl Prinz zu Lowenstein, Kleingemund, near Neckargemund, Germany.

1. The process substantially as described, which consists in supplying a compressed fluid to an engine, admitting a heat carrier to said engine, allowing the fluid and heat carrier to expand, causing the fluid to absorb the heat of said carrier, and finally recompressing the fluid and returning it to its source of supply.

1,220,037. APPARATUS FOR INDICATING THE COMPOSITION OF GASES. Hans Haupt and Martin Werner, Berlin, Germany.

1,220,076. PNEUMATIC ACTION FOR PLAYER-PIANOS. Jesse L. A. De Yoe and John W. De Yoe, Castleton, N. Y.



PNEUMATIC PATENTS MARCH 27

1,220,100. FLUID-PRESSURE HAMMER. Charles H. Haeseler, Philadelphia, Pa.

1,220,103. DEVICE FOR PROJECTING BURNING LIQUIDS. William A. Hall, New York, N. Y.

MARCH 27.

1,220,297. VACUUM APPARATUS. Harold Vanderhoof, San Francisco, Cal.

1,220,323. PNEUMATIC RETRIEVING-TROLLEY. Albert M. Eaton, Santa Monica, Cal.

1,220,336. FLUID-PRESSURE SYSTEM. Harry H. Hornsby, Chicago, Ill.

1,220,497. AIR-MOISTENING ATTACHMENT FOR INCUBATORS. William Lansing Cornell, Brown Mills, N. J.

1,220,503. AIR-PIPE COUPLING. Henry C. Duty and Leroy L. Craig, Pittsburg, Ill.

1,220,538. AIR-REMOVING DEVICE FOR WATER-PIPE LINES. Charles A. Olson, Geneva, Ill.

1,220,551. PNEUMATIC STABILIZER FOR VESSELS. George E. Powell, Chicago Heights, Ill.

1. A vessel having stabilizing chambers in opposite sides, communicating with the water through openings below the normal water line, each chamber having a valve and a vent controlled by said valve and means to cause said valve to open when said stabilizing chamber rises by a roll of the vessel and permit free ingress of water to said chamber, and to close when said chamber moves downwardly.

1,220,618. WAVE-MOTOR. Herbert E. Fisher, San Francisco, Cal.

The combination with a float having an air receiver thereon of a pair of hollow cone-shaped members; a flexible diaphragm consisting of radial members thereby forming a pressure chamber adapted to be normally compressed by the pressure of surrounding water; a covering of flexible fabric secured above the radial members; a second radial member interposed between the first mentioned members and the fabric and secured to every alternate radial member and overlapping each adjacent radial member thereby preventing pressure from forcing the fabric between the first mentioned members; suitable flexible connections between the air chambers and the air receiver on the float; and a suitable cable secured to each cone-shaped member and the diaphragm therefor and to each end of the float, and adapted to raise the diaphragm and thereby expand the compression chamber and to raise the cone-shaped member when said compression chamber is expanded, when that end of the float is raised by the action of waves.

1,220,628. FAN ATTACHMENT FOR CHAIRS. Albert Edmond Hauser, Pelican, La.

1,220,630. AIR-CUSHION DEVICE FOR VEHICLES. Ralph Victor Hayes, Brooklyn, N. Y.

1,220,641. VACUUM-CREATING AND DUST-SEPARATING MACHINE. Bert M. Kent, Washington, D. C.

1,220,706. ROTARY-CYLINDER MOTOR. Felix Joseph Charlemagne Tesse, La Varenne St. Hilaire, France.

1,220,805. AIR-DISTRIBUTER FOR INTERNAL-COMBUSTION ENGINES. Carl W. Weiss, Brooklyn, N. Y.